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THE

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A MONOGRAPH

OF THE

CRETACEOUS LAMELLIBRANCHIA

OF

ENGLAND.

BY

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PART II.

TRIGONIIDÆ, MYTILIDÆ, AND DREISSENSIIDÆ.

PAGES 73—112; PLATES XV—XIX.

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and hinge-area; it is therefore possible that this form may belong to *Pectunculus*.

Distribution.—Chalk Rock (zone of *Heteroceras Reussianum*) of Cuckhamsley.

Family—TRIGONIIDÆ, *Lamarck.*

Genus—TRIGONIA, *Bruguière*, 1789.

(‘Encyc. Méth. Vers.,’ vol. i, p. xiv; Lamarck, ‘Syst. Anim. sans Vert.,’ 1801, p. 116.)

The British forms of this genus have already been considered in detail by Mr. Lycett in his ‘Monograph of the British Fossil Trigoniæ,’ published by the Palæontographical Society in 1872–9; it will therefore not be necessary, in the present work, to do more than enumerate the Cretaceous species, and to give some additional notes on their affinities, synonymy, etc.

Section 1.—SCAPHOIDEÆ.

TRIGONIA SCAPHA, *Agassiz*, 1840. Plate XX, figs. 1, 2.

Additional Synonymy.

1861.	TRIGONIA HUNSTANTONENSIS, *H. Seeley*.	Ann. Mag. Nat. Hist., ser. 3, vol. vii, p. 123, pl. vi, fig. 9.
1877.	— SCAPHA, *Lycett*,	p. 183, pl. xxxviii, fig. 6.
1884.	— — *O. Weerth.*	Die Fauna Neocom. im Teutoburg. Walde (Palæont. Abhandl., vol. ii), p. 45.
1896.	— — *A. Wollemann.*	Zeitschr. d. deutschr. geol. Gesellsch., vol. xlviii, p. 846.
1900.	— — —	Die Biv. u. Gastrop. d. deutsch. u. holländ. Neocoms. (Abhandl. d. k. preussisch. geol. Land., N. F., pt. 31), p. 92.

(iii) *L. radiata.* Alth, ibid., p. 234, pl. xii, fig. 19; Favre, ibid., p. 122, pl. xii, fig. 13.

(iv) *L. plana.* Römer, ‘Die Verstein. des norddeutsch. Kreidegeb.’ (1841), p. 69, pl. viii, fig. 24; Griepenkerl, “Senon. Kreide von Königslutter,” ‘Palæont. Abhandl.,’ vol. iv (1889), p. 56. In this form the valves appear to be flatter and the umbones less prominent than in the English species described above.

(v) *Pectunculus? insculptus*, Reuss, ‘Die Verstein. der böhm. Kreideformat.,’ pt. ii (1846), p. 8, pl. xxxv, fig. 5; Fritsch, ‘Stud. im Gebiete der böhm. Kreideformat., v. Priesener Schichten’ (1893), p. 98, fig. 106.

Remarks.—From Agassiz' figures alone it would be difficult to feel sure of the identity of the English form, described by Seeley as *T. hunstantonensis*, with *T. scapha*, Agassiz; but the figures of Pictet and Campiche give a much better idea of the characters of the species. Seeley's figure is more accurate than Lycett's, but the arrangement of the tubercles is not satisfactorily shown.

Types.—The type of *T. scapha* is from the Neocomian near Neuchâtel. The type of *T. hunstantonensis* is in the Woodwardian Museum; it was at first stated to come from the Red Chalk, but the matrix differs entirely from the Red Chalk, and the specimen in all probability is from the Snettisham Ironstone nodules[1] (Lower Greensand), West Norfolk.

Distribution.—Snettisham Ironstone of Sandringham Warren and Wolferton Station. Snettisham Clay of Heacham and Snettisham. The records of this species from the Red Chalk of Hunstanton are probably erroneous.

TRIGONIA EXALTATA, *Lycett*, 1877.

1877. *Lycett*, p. 184, pl. xxxviii, fig. 2.

Type.—In the British Museum.

Distribution.—Lower Greensand of West Norfolk.

TRIGONIA ROBINALDINA? *d'Orbigny*, 1844.

1844.	TRIGONIA	ROBINALDINA,	*A. d'Orbigny.*	Pal. Franç. Terr. Crét., vol. iii, p. 139, pl. ccxcix, figs. 1, 2.
1850.	—	—	—	Prodr. de Pal, vol. ii, p. 78.
1866.	—	—	*F. J. Pictet and G. Campiche.*	Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 385.

An internal cast from the Tealby Limestone (zone of *Bel. brunsvicensis*) of Claxby, now in the Woodwardian Museum, probably belongs to this species.

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[1] See Lamplugh, in Whitaker and Jukes-Browne, "Geol. Borders of the Wash" ('Mem. Geol. Survey,' 1899), p. 16, etc.

Section 2.—CLAVELLATÆ.

TRIGONIA INGENS, *Lycett*, 1872.

1872. *Lycett*, p. 24, pl. viii, figs. 1—3.
1877-9. Ibid., p. 207, pl. xxxvi, figs. 5, 6.
1877. TRIGONIA KEEPINGI, *Lycett*. Ibid., p. 196, pl. xxxv, figs. 1, 2.

Remarks.—Maas[1] states that his *T. roelligiana*, from the Gault of Wilhelmshöhe, near Langenstein, is related to *T. ingens*; but it seems to be clearly distinguished by the greater curvature of the ribs near the carina and the indistinctness or absence of tubercles.

T. Keepingi, Lycett, is known only by the two type specimens from the Spilsby Sandstone. I have carefully compared these with a large series of *T. ingens* from the Claxby Ironstone—the chief horizon for that species, and find that the curvature and number of the costæ and the size of the tubercles vary considerably in different specimens of *T. ingens;* some forms possessing smaller and more numerous tubercles agree perfectly, in these respects, with *T. Keepingi.* The plications on the area of the smaller specimen of *T. Keepingi* are quite similar to those on *T. ingens;* but on the larger specimen they are less distinct than usual; this, I think, is accounted for by imperfect preservation. In comparing the form of the shell in the larger example of *T. Keepingi* with that of *T. ingens* it is important to note that that specimen is larger than usual, and that the whole of the marginal parts posterior to the umbo are very imperfect, so that a false idea may at first be taken of the height of the shell. Lycett's figures, although giving a good idea of the character of the shell, are not accurate in either outline or size.

Types.—*T. ingens*, from the Carstone of Downham, was formerly in the museum at Lynn, but cannot now be found. Specimens figured on Lycett's plate xxxvi, from the Claxby Ironstone, are in the Museum of Practical Geology; and also a gutta-percha cast of the original of plate viii, fig. 1.

T. Keepingi, from the Spilsby Sandstone, in the Woodwardian Museum.

Distribution.—Spilsby Sandstone (zone of *Bel. lateralis*) of Claxby and Donnington. Claxby Ironstone (zone of *Bel. lateralis*) of Benniworth Haven. Carstone of Downham, Norfolk.

The specimens named *T. Keepingi* are from the Spilsby Sandstone (zone of *Bel. lateralis*) of Claxby and Tealby.

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[1] 'Zeitschr. d. deutsch. geol. Gesellsch.,' vol. xlvii (1895), p. 282, pl. ix, fig. 7.

Section 3.—GLABRÆ.

TRIGONIA ECCENTRICA, *Parkinson*, 1811.

1811. TRIGONIA ECCENTRICA, *J. Parkinson.* Org. Remains, vol. iii, p. 175, pl. xii, fig. 5.
1811. — SINUATA, *Parkinson.* Ibid., p. 177, pl. xii, fig. 13.
1818. — ECCENTRICA, *J. Sowerby.* Min. Conch., vol. iii, p. 11, pl. ccviii, figs. 1, 2.
1828. — EXCENTRICA, *Defrance.* Dict. Sciences nat., vol. lv, p. 296.
1837. — — *G. G. Pusch.* Polens Paläont., p. 61.
1837. — SINUATA, *Pusch.* Ibid., p. 61.
1840. — EXCENTRICA, *L. Agassiz.* Études crit. Moll. Foss. (Trigon.), p. 9.
1848. LYRIODON SINUATUS, *H. G. Bronn.* Index Palæont., vol. i, p. 688 (*partim*).
1848. — EXCENTRICUS, *Bronn.* Ibid., p. 686 (*partim*).
1850. TRIGONIA EXCENTRICA, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 162.
1854. — — *J. Morris.* Cat. Brit. Foss., ed. 2, p. 228.
1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 387.
1866. — SINUATA, *Pictet and Campiche.* Ibid., p. 387 (*partim*).
1875. — EXCENTRICA, *Lycett*, p. 94 (*partim*), pl. xx, fig. 6 (not 5); pl. xxi, fig. 6; pl. xxii, fig. 5; pl. xxviii, figs. 6, 9, 10.

Non 1837. LYRODON EXCENTRICUM, *A. Goldfuss.* Petref. Germ., vol. ii, p. 203, pl. cxxxvii, fig. 8 (= *Trigonia Micheloti*, de Loriol).
— 1847. TRIGONIA EXCENTRICA, *J. Müller.* Petref. Aachen. Kreideformat., pt. 1, p. 16.
— 1847. — SINUATA, *A. d'Orbigny.* Voy. Astrol. Paléont., pl. iv, figs. 29, 30.

Remarks.—This is distinguished from *T. affinis*, Sowerby, by being proportionately longer, more produced posteriorly, less ovoid in outline, and in having the costæ near the antero-ventral margin less regularly concentric (except in small specimens).

Types.—I have not seen Parkinson's types. The specimen figured by Sowerby is in the British Museum. Specimens figured by Lycett are in the Museum of Practical Geology (pl. xxi, fig. 6; pl. xxii, fig. 5), and in Mr. Vicary's collection (pl. xx, fig. 6; pl. xxviii, figs. 6, 9, 10). The original of pl. xx, fig. 5, stated by Lycett to be from Blackdown, is in the British Museum (No. 32396); it is really from the Cenomanian of Le Mans, and is an example of *T. sinuata*, d'Orbigny (*non* Parkinson)—see *T. affinis*.

Distribution.—Greensand of Blackdown (Zone xi), Haldon, and Kingskerswell.

TRIGONIA LÆVIUSCULA, *Lycett*, 1875.

1875. *Lycett*, p. 96, pl. xxii, fig. 6.

Remarks.—I doubt whether this can be regarded as more than a variety of *T. eccentrica*, Parkinson. The only specimens I have seen are those referred to by Lycett. More material is needed to allow of a definite opinion being given.

Type.—From the Greensand of Cullompton; in Mr. Vicary's collection.

Distribution.—Blackdown Greensand of Collumpton. Lycett states that this species was obtained by Mr. Meÿer from the Cenomanian of Dunscombe, but the specimens do not appear to be in Mr. Meÿer's collection.

TRIGONIA AFFINIS, *Sowerby*, 1818.

1818. TRIGONIA AFFINIS, *J. Sowerby* (ex *Miller*, MS.). Min. Conch., vol. iii, p. 11, pl. ccviii, fig. 3.
1828. — — *Defrance.* Dict. Sciences nat., vol. lv, p. 297.
1840. — — *L. Agassiz.* Études crit. Moll. Foss. (Trigon.), p. 9.
1844. — SINUATA, *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 147, pl. ccxciii.
1848. LYRIODON SINUATUS, *H. G. Bronn.* Index Palæont., vol. i, p. 688 (*partim*).
1850. TRIGONIA SINUATA, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 161.
1854. — — *J. Morris.* Cat. Brit. Foss., ed. 2, p. 229.
? 1867. — — *E. Guéranger.* Album Paléont. de la Sarthe, p. 14, pl. xix, fig. 4.
1875. — EXCENTRICA, *Lycett*, pl. xx, fig. 5 (from Le Mans).
1877. — AFFINIS, *Lycett*, p. 187, pl. xxi, fig. 7; pl. xl, fig. 2 (from Le Mans).
1896. — — *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 153.

Remarks.—I have compared examples of this species with *T. sinuata*, d'Orbigny (*non* Parkinson), from the Cenomanian of Le Mans, and consider that, as maintained by d'Orbigny, the two are identical. Two specimens from Le Mans were accidentally figured by Lycett as English examples (see below).

Types.—The type is in the Bristol Museum. One of the specimens figured by Lycett (pl. xl, fig. 2) is in Mr. Vicary's collection; the other (pl. xxi, fig. 7), stated to be from Blackdown, is in the British Museum (No. 32396), and was really obtained from the Cenomanian of Le Mans; the original of pl. xx, fig. 5 (figured as *T. excentrica*), is also from the same locality, and is in the British Museum. Casts of these two specimens, labelled *T. sinuata* by Lycett, are in the Scarborough Museum.

Distribution.—Greensand of Blackdown and Haldon. ? Cenomanian of Axmouth Meÿer collection.

TRIGONIA DUNSCOMBENSIS, *Lycett*, 1877. Plate XIX, figs. 12 *a*, *b*.

1877. *Lycett*, p. 188, pl. xl, figs. 5, 6; pl. xli, fig. 14.
1896. *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 153.

Remarks.—Messrs. Jukes-Browne and Hill consider that *T.* ***dunscombensis*** is probably identical with *T. sinuata*, d'Orbigny (*non* Parkinson) which I regard as a synonym of *T. affinis* (see p. 77). Small forms (35 mm. long) seem to be inseparable, unless it is by the somewhat greater convexity of *T.* ***dunscombensis***, but the larger examples of the latter (*e. g.* Lycett's fig. 5) seem to differ in having a less ovoid outline and fewer ribs. More specimens of *T.* ***dunscombensis*** are needed before its affinities can be definitely settled.

Types.—Figs. 5 and 6, from near Sidmouth, are in Mr. Meÿer's collection. The original of pl. xli, fig. 14, from Dunscombe, is in the Museum of Practical Geology.

Distribution.—Cenomanian (Beds 10, 11, and 12 of Meÿer) of Dunscombe, Branscombe, Whitecliff, and Pinhay; Bed 11 of Humble Point, Lyme Regis. Base of Chalk Marl (zone of *Schlœnbachia varians*) of Titherleigh.

TRIGONIA DEBILIS, *Lycett*, 1877.

1877. *Lycett*, p. 189, pl. xl, fig. 8; pl. xli, fig. 5.
1896. *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 154.

Types.—In Mr. Meÿer's collection (fig. 8), and in the Museum of Practical Geology (fig. 5).

Distribution.—Cenomanian (Bed 10) of Dunscombe.

Section 4.—QUADRATÆ.

TRIGONIA NODOSA, *Sowerby*, 1826.

1822. TRIGONIA CLAVELLATA, *G. Mantell* (non *Sowerby*). Foss. S. Downs, p. 73.
1826. — NODOSA, *J. de C. Sowerby.* Min. Conch., vol. vi, p. 7, pl. dvii, fig. 1.
? 1840. — CINCTA, *L. Agassiz.* Etudes crit. Moll. Foss. (Trigon.), p. 27, pl. vii, figs. 21, 23; pl. viii, figs. 2—4.
1844. — RUDIS, *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 137, pl. cclxxxix.

1850. TRIGONIA RUDIS, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 78 (*? partim*).
1854. — NODOSA, *J. Morris.* Cat. Brit. Foss., ed. 2, p. 229.
? 1855. — RUDIS, *G. Cotteau.* Moll. Foss. de l'Yonne, p. 76.
1857. — DÆDALEA, *F. J. Pictet and E. Renevier.* Foss. Terr. Aptien (Matér. Pal. Suisse, ser. 1), p. 92, pl. xii, fig. 1.
1857. — NODOSA, *Pictet and Renevier.* Ibid., p. 94, pl. xii, fig. 2.
1865. — — *H. Coquand.* Mon. Aptien de l'Espagne, p. 133.
1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 385.
1875. — — *Lycett,* p. 106, pl. xxv, figs. 1, 2; pl. xxxvii, figs. 5, 6.
1875. — — var. ORBIGNYANA, *Lycett.* Ibid., p. 107, pl. xxiv, figs. 1—3.
1896. — — *A. Wollemann.* Zeitschr. d. deutsch. geol. Gesellsch., vol. xlviii, p. 846.
1900. — — — Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc. (Abhandl. d. k. preussisch. geol. Land., N. F., pt. 31), p. 90, pl. iv, fig. 8.

Non 1852. — — *F. J. Pictet and W. Roux.* Moll. Foss. Grès verts de Genève, p. 454, pl. xxxv, fig. 5.

Remarks.—There appears to be a perfect passage from the typical *T. nodosa* to the variety named by Lycett *Orbignyana.*

Lycett regarded *T. cincta*, Agassiz, as a synonym of *T. nodosa;* I have seen no examples of the former, but its area appears to be proportionately larger, while the ribs seem to be more nearly perpendicular to the carina and more nearly parallel to the ventral margin than in the English specimens.

Types.—I have not found the type; it came from the Hythe Beds of Hythe. The specimens figured by Lycett are in the Museum of Practical Geology.

Distribution.—Hythe Beds of Hythe and Lympne. Crackers of Atherfield. *Perna*-bed of Atherfield and Redcliff. Folkestone Beds near Copt Point, Folkestone. Claxby Ironstone of Tealby (*fide* Lycett).

TRIGONIA TEALBYENSIS, *Lycett*, 1875.

1875. *Lycett,* p. 114, pl. xxviii, fig. 7.

Type.—In the Woodwardian Museum, Cambridge.

Distribution.—Spilsby Sandstone (zone of *Bel. lateralis*) of Claxby.

TRIGONIA DÆDALEA, *Parkinson*, 1811.

Additional Synonymy.

1828. TRIGONIA DÆDALEA, *Defrance*. Dict. Sciences nat., vol. lv, p. 294.
1868. — — *A. Briart and F. L. Cornet*. Descript. Mineralog. Géol. et Pal. de la Meule de Bracquegnies (Mém. cour. et Mém. des Sav. étrangers, vol. xxxiv), p. 64, pl. vi, figs. 1—3.
1875. — — *Lycett*, p. 100, pl. xxii, figs. 7, 8; pl. xxiii, figs. 2, 3; pl. xxviii, fig. 8.
1875. — — var. CONFUSA, *Lycett*, p. 102, pl. xxiii, fig. 1.

Non 1819. — DÆDALEA, *Lamarck*. Anim. sans Vert., vol. vi, p. 63 (ed. 2, 1835, p. 516), from Le Mans.
— 1866. — — *F. J. Pictet and G. Campiche*. Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 371.

Remarks.—Lycett regarded *T. palmata*, Deshayes,[1] as a variety of *T. dædalea;* but it should be noted that the former occurs at a distinctly lower horizon than the latter, namely, in the Middle Neocomian of the Aube. I have seen no example of *T. palmata*.

Types.—I have not found the type. The specimens figured by Sowerby are in the British Museum; those figured by Lycett are in the Museum of Practical Geology, except the type of the variety *confusa*, which is in Mr. Vicary's collection. The type of *T. quadrata*, Sowerby, is in the Bristol Museum.

Distribution.—Greensand of Blackdown (Zone xii) and Haldon.

TRIGONIA SPECTABILIS, *Sowerby*, 1826.

1875. *Lycett*, p. 112, pl. xxxvi, figs. 1—4.

Remarks.—I do not think that Lycett's view of the identity of the species figured by Pictet and Roux[2] as *T. nodosa* with *T. spectabilis* can be maintained. In the former the area is smaller, the posterior extremity more produced and rounded, the tubercles smaller and more rounded and not forming such distinct rows as in *T. spectabilis*.

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[1] 'Mém. Soc. géol. France,' vol. v (1842), p. 7, pl. viii, fig. 5.

[2] 'Moll. Foss. Grès verts de Genève' (1852), p. 454, pl. xxxv, fig. 5.

Types.—I have not found the type. The specimens figured by Lycett are in the Museum of Practical Geology (figs. 1—3), and in Mr. Vicary's collection (fig. 4).

Distribution.—Blackdown Greensand (Zone x).

Section 5.—SCABRÆ.

TRIGONIA ETHERIDGEI, *Lycett*, 1875.

1875. *Lycett*, p. 127, pl. xxvii, figs. 1—3.

Types.—In the Museum of Practical Geology.

Distribution.—*Perna*-bed of Atherfield.

TRIGONIA CAUDATA, *Agassiz*, 1840.

Additional Synonymy.

? 1852. TRIGONIA ALIFORMIS, *F. J. Pictet and W. Roux.* Moll. Foss. Grès verts de Genève, pl. xxxv, fig. 1 (not fig. 2), p. 450.
1866. — CAUDATA, *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 374.
1869. — — *P. de Loriol and V. Gilliéron.* Mon. Urgonien Infér. du Landeron (Mém. Soc. helvét. Sci. nat., vol. xxiii), p. 15.
1875. — — *Lycett*, p. 129, pl. xxvi, figs. 5—7.
1895. — — *G. Maas.* Zeitschr. der deutsch. geol. Gesellsch., vol. xlvii, p. 264.
1900. — — *A. Wollemann.* Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc. (Abhandl. d. k. preussisch. geol. Land., N. F., pt. 31), p. 89.

Types.—From the Neocomian of Neuchâtel. The specimens figured by Lycett are in the Museum of Practical Geology.

Distribution.—Crackers of Atherfield. Recorded by Topley (1875) from several localities in the Weald—I have not seen the specimens; it is probable that some of them are examples of *T. vectiana.*

TRIGONIA SCABRICOLA, *Lycett*, 1875.

1875. *Lycett*, p. 130, pl. xxvii, figs. 4, 5.

Remarks.—This form is very closely connected with *T. caudata* from the Lower Greensand—indeed, some specimens appear to be almost inseparable from that species; but the majority of the Upper Greensand examples have rather more numerous and closer ribs towards the umbo, the shell less produced posteriorly, and its height somewhat greater in proportion. It should, however, be noted that a specimen from the Aptian of the Perte-du-Rhône, figured by Pictet and Renevier,[1] agrees perfectly with examples of *T. scabricola* from Blackdown and Haldon.

Types.—From Blackdown, in the Museum of Practical Geology.

Distribution.—Greensand of Blackdown, Haldon, and Devizes.

TRIGONIA CRENULIFERA, *Lycett*, 1877.

1877. *Lycett*, p. 189, pl. xl, figs. 1, 7, 9.
1896. *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 154.

Remarks.—The more prominent and fewer costæ, and the greater slope of the area and escutcheon, which Lycett regarded as features distinguishing this from *T. crenulata*, d'Orbigny, vary considerably in different specimens, as may be seen by comparing Lycett's figures 1 and 9. In one example of *T. crenulata* in the British Museum, from Le Mans, the costæ are actually fewer than in a form of *T. crenulifera* of the same size. The costellæ on the area, however, seem to separate *T. crenulifera* from *T. crenulata;* in the latter they appear to be found only near the anterior end of the area.

Types.—In Mr. Meÿer's collection (figs. 1 and 7), and in the Museum of Practical Geology (fig. 9).

Distribution.—Cenomanian (Beds 10 and 11), near Beer Head, Dunscombe, and Pinhay Cliff.

TRIGONIA CRENULATA, *Lamarck*, 1819. Plate XIX, fig. 14.

1819. TRIGONIA CRENULATA, *Lamarck.* Anim. sans vert., vol. vi, p. 63.
1828. — — *Defrance.* Dict. Sciences nat., vol. lv, p. 294.

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[1] "Foss. Aptien de la Perte du Rhône" ('Matér. Pal. Suisse,' ser. 1, 1857), pl. xiii, fig. 1.

1835. Trigonia crenulata, *Lamarck.* Ibid., ed. 2, vol. vi, p. 515.
1840. — — *L. Agassiz.* Études crit. Moll. Foss. (Trigon.), p. 32, pl. vi, figs. 4—6.
1844. — — *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 151, pl. ccxcv.
1848. Lyriodon crenulatus, *H. G. Bronn.* Index Palæont., vol. i, p. 186.
1850. Trigonia crenulata, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 161.
1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 388.
1867. — — *E. Guéranger.* Album Paléont. de la Sarthe, p. 14, pl. xviii, figs. 3, 4.
? 1878. — — *O. Fraas.* Aus dem Orient., vol. ii, Geol. Beobacht. Libanon, p. 70.
1896. — — *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 154.

Remarks.—I have seen only one English example of this. The surface is not quite perfectly preserved, so that the rugose character of the costæ is not well seen.

Type.—From the Cenomanian of Le Mans.

Distribution.—Cenomanian (Meÿer's Bed 10) of Dunscombe.

Trigonia aliformis, *Parkinson*, 1811.

Additional Synonymy.

1828. Trigonia alæformis, *Defrance.* Dict. Sciences nat., vol. lv, p. 297.
1850. — aliformis, *G. P. Deshayes.* Traité Elément. Couch., vol. ii, p. 258, pl. xxxiii, fig. 3.
? 1865. — — *H. Coquand.* Mon. Aptien de l'Espagne, p. 134.
? 1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), pp. 377, 386, pl. cxxviii, fig. 9.
1875. — — *Lycett*, p. 116, pl. xxv, figs. 3—6; pl. xxviii, fig. 5.
1897. — — *R. B. Newton.* Proc. Dorset Nat. Hist. and Antiq. Field Club, vol. xviii, p. 95, pl. iii, fig. 14.

Non 1841. — alæformis, *F. A. Römer.* Die Verstein. des nord-deutsch. Kreidegeb., p. 68.
— 1843. — — *H. B. Geinitz.* Die Verstein. von Kieslingswalda, p. 14, pl. ii, figs. 15, 16.
— ? 1846. — — *A. E. Reuss.* Die Verstein. der böhm. Kreideformat., pt. 2, p. 5.
— 1847. — — *J. Müller.* Mon. Petref. der Aachen. Kreideformat., pt. 1, p. 15.
— 1863. — aliformis, *R. Drescher.* Zeitschr. d. deutsch. geol. Gesellsch., vol. xv, p. 348.

Non 1873. TRIGONIA ALIFORMIS, *H. B. Geinitz.* **Das Elbthalgeb. in Sachsen (Palæontographica, vol. xx), pt. 2, p. 58.**
— 1897. — ALÆFORMIS, *A. Fritsch.* Stud. **im Gebiete der böhm. Kreideformat. vi. Die Chlomeker Schichten, p. 55, fig. 60.**

Types.—From Blackdown. I have not been able to trace the type. Sowerby's specimens are in the British Museum, except the original of fig. 3, which is in the Bristol Museum. The specimens figured by Lycett are in the Museum of Practical Geology (figs. 3—6), and in Mr. Vicary's collection (pl. xxviii, fig. 5). The specimen figured by Newton is in the British Museum.

Distribution.—Greensand of Blackdown (Zones iv to vi) and Devizes. Stated by Lycett to occur at Haldon, but not recorded by Downes (1882); I have seen no example from that locality. Zone of *Hoplites interruptus* of Okeford Fitzpaine. The variety *attenuata* is found in the Upper Greensand of Niton, Ventnor, and Warminster. Agassiz'[1] record of this form from the Greensand near Cambridge is erroneous. ? Folkestone Beds of Copt Point, Folkestone.

TRIGONIA MEYERI, *Lycett*, 1875.

1875. *Lycett*, p. 125, pl. xxiii, fig. 6; pl. xli, figs. 15, 16.
1896. *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 154.

Types.—In the Museum of Practical Geology—from near Sidmouth and Dunscombe.

Distribution.—Cenomanian (Meÿer's Beds 10, 11, 12) of Dunscombe, Culver Hole (Devon), west of Pinhay, etc. Base of Chalk Marl (zone of *Schlœnbachia varians*) of Titherleigh, near Chard.

TRIGONIA VECTIANA, *Lycett*, 1875.

Additional Synonymy.

1818. TRIGONIA ALÆFORMIS, *J. Sowerby.* Min. Conch., vol. iii, p. 27 (*partim*), pl. ccxv, fig. 2 (not 1, 3, 4).
1875. — VECTIANA, *Lycett*, p. 123, pl. xxiv, figs. 10, 11; pl. xxv, fig. 7.

Types.—Museum of Practical Geology—from the *Perna*-bed of Atherfield.

Distribution.—*Perna*-bed and Bed 45 (Fitton) of Atherfield. *Perna*-bed of

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[1] 'Études crit. Moll. Foss.,' Trigon. (1840), p. 31.

Redcliff, near Sandown. Ferruginous Sands of Shanklin. Hythe Beds of Hythe, etc. Atherfield Beds of Sevenoaks. Lower Greensand of Seend (*fide* Lycett). Sandgate Beds of Parham Park.

TRIGONIA ORNATA, *d'Orbigny*, 1844. Plate XIX, fig. 13.

Additional Synonymy.

? 1855. TRIGONIA ORNATA, *G. Cotteau.* Moll. Foss. de l'Yonne, p. 76.
? 1858. — — *J. Vilanova-y-Piera.* Mém. Geogr.-agric. de Castellon, pl. ii, fig. 14.
? 1865. — — *H. Coquand.* Mon. Aptien de l'Espagne, p. 137.
1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), pp. 373, 385.
1867. — — *P. de Loriol.* In A. Favre, Rech. géol. dans Savoie, etc., vol. i, p. 379, pl. c, fig. 8.
? 1871. — — *W. A. Ooster and C. v. Fischer-Ooster.* Protoz. Helvet., vol. ii, p. 101, pl. xv, fig. 18.
1875. — — *Lycett,* p. 139, pl. xxiv, figs. 6, 7.
1884. — sp. indet. (2nd), *O. Weerth.* Die Fauna Neocom. im Teutoburg. Walde (Palæont. Abhandl., vol. ii), pp. 45, 46.
1896. — ORNATA, *A. Wollemann.* Zeitschr. d. deutsch. geol. Gesellsch., vol. xlviii, p. 847.
? 1899. — — *G. Maas.* Ibid., vol. li, p. 248.
1900. — — *A. Wollemann.* Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc. (Abhandl. d. k. preussisch. geol. Land., N. F., pt. 31), p. 88.

Remarks.—The English specimens agree better with the example figured by Pictet and Renevier than with the type, in which the costæ are less numerous. A specimen from Lympne (Plate XIX, fig. 13) possesses fewer costæ than the examples found at Atherfield, and in this character, as also in general shape, it approaches more nearly the foreign examples.

The specimen from Shorncliffe, figured by Sowerby[1] as *T. spinosa*, var., has been regarded by several authors as *T. Archiaciana*, d'Orbigny; but I think it is more likely to be an example of *T. ornata*. I have not been able to trace the specimen.

Types.—The specimens figured by Lycett are in the Museum of Practical Geology.

Distribution.—*Perna*-bed of Atherfield. Ferruginous Sands of Shanklin. Hythe Beds of Hythe, Lympne, and near Maidstone.

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[1] 'Trans. Geol. Soc.,' ser. 2, vol. iv (1836), pp. 131, 338, pl. xiii, fig. 3.

TRIGONIA UPWARENSIS, *Lycett*, 1875.

1875. TRIGONIA UPWARENSIS, *Lycett*, p. 143, pl. xxiii, figs. 8, 9; pl. xxxix, fig. 4.
1883. — — *W. Keeping.* Foss., etc., Neoc. Upware and Brickhill, p. 113.

Remarks.—This species is allied to *T. Archiaciana*, d'Orbigny, but the costæ are more numerous and have greater curvature near the anterior border. The costellæ on the area appear to be generally more numerous and more nearly perpendicular to the carina. The outline of the larger specimens appears to be more rounded than in *T. Archiaciana.*

Types.—In the Museum of Practical Geology. The specimen figured on Lycett's pl. xxxix is in the collection of Mr. J. F. Walker.

Distribution.—Lower Greensand of Upware.

TRIGONIA ARCHIACIANA, *d'Orbigny*, 1844.

Additional Synonymy.

1866. TRIGONIA ARCHIACIANA. *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 380.
1875. — — *Lycett*, pp. 140, 202 (*partim*), not the figures.

Remarks.—It seems doubtful whether this species occurs in England; I have seen two specimens from the *Perna*-bed of Atherfield and Sandown, which may perhaps belong to it; but they are not sufficiently perfect for exact determination. The surface of the specimen from the Gault of Okeford Fitzpaine, figured by Newton,[1] has perished, so that I am unable to give any opinion as to its affinities.

TRIGONIA SPINOSA, *Parkinson*, 1811.

Additional Synonymy.

1875. TRIGONIA SPINOSA, *Lycett*, p. 136, pl. xxiii, fig. 10; pl. xxiv, figs. 8, 9; pl. xxviii, figs. 1, 2.
? 1881. — — *J. Kiesow.* Schrift. d. nat. Gesellsch. in Danzig, vol. v, p. 413.

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[1] 'Proc. Dorset Nat. Hist. and Antiq. Field Club,' vol. xviii (1897), p. 96, pl. iii, fig. 16.

? 1885. Trigonia spinosa, *F. Nötling.* Die Fauna d. baltisch. Cenoman. (Palæont. Abhandl., vol. ii), p. 27, pl. iv, figs. 16, 17.

? Non 1837. — — *F. Dujardin.* Mém. Soc. géol. France, vol. ii, p. 224.
— 1844. — — *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 154, pl. ccxcvii, figs. 1—5.
— 1850. — — *d'Orbigny.* Prodr. de Pal., vol. ii, p. 161.

Types.—The type, from Blackdown, and the specimen figured by Sowerby, are in the British Museum.

The originals of Lycett's pl. xxiii, fig. 10, and pl. xxviii, fig. 1, 2, are in the Museum of Practical Geology; of pl. xxiv, fig. 8, in the Wiltshire Collection, Woodwardian Museum; of pl. xxiv, fig. 9, in the Williamson Collection, Manchester Museum.

Distribution.—Greensand of Blackdown.

Trigonia Vicaryana, *Lycett*, 1875.

1844. Trigonia spinosa, *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 154, pl. ccxcvii, figs. 1—5 (non *T. spinosa*, Park.).
1850. — — *d'Orbigny.* Prodr. de Pal., vol. ii, p. 161.
1867. — — *E. Guéranger.* Album Paléont. de la Sarthe, p. 14, pl. xviii, fig. 2.
1875. — Vicaryana, *Lycett*, pp. 141, 203, pl. xxiii, fig. 7; pl. xxv, figs. 8, 9; pl. xxviii, fig. 4; pl. xl, figs. 3, 4.
? 1882. — pseudospinosa, *P. de Loriol.* Gault de Cosne (Mém. Soc. Pal. Suisse, vol. ix), p. 99, pl. xii, figs. 12—14.
1896. — Vicaryana, *A. J. Jukes-Browne and W. Hill.* Quart. Journ. Geol. Soc., vol. lii, p. 154.

Remarks.—This is relatively higher and shorter than *T. Archiaciana*, d'Orbigny, *T. upwarensis*, Lycett, and *T. ornata*, d'Orbigny. The costellæ on the area are more oblique to the carina than in *T. upwarensis*. The costæ are more numerous than in *T. ornata*.

T. Ludovicæ, Briart and Cornet,[1] from Bracquegnies, is more produced posteriorly, it has fewer ribs anteriorly, and closer ribs posteriorly, than *T. Vicaryana*.

De Loriol figures a form from the Gault of Cosne, which he regards as *T. spinosa*, d'Orbigny, *non* Sowerby, and names *T. pseudospinosa*, but it seems to possess fewer and stronger costellæ on the area than *T. spinosa*, d'Orbigny, which is here considered to be identical with *T. Vicaryana*, Lycett.

Types.—From the Greensand near Sidmouth and Haldon; in the Museum of Practical Geology (Lycett's pl. xxv, fig. 8), and Mr. Vicary's collection (fig. 9).

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[1] 'Descript. de la Meule de Bracquegnies' (1868), p. 65, pl. vi, figs. 6, 7.

Other figured specimens are in Mr. Vicary's collection (pl. xxiii, fig. 7—from Haldon, *not* Blackdown as stated by Lycett; and pl. xxviii, fig. 4), and in Mr. Meÿer's collection (pl. xl, figs. 3, 4).

Distribution.—Greensand of Haldon, Kingskerswell, and near Weymouth. Cenomanian of Dunscombe, Branscombe, and Beer Head (Meÿer's Beds 10, 11 and 12); and of Pinhay (Bed 10). Base of Chalk Marl (zone of *Schlœnbachia varians*) of Eggardon Hill, Chard, Chardstock, and Titherleigh (near Chard).

TRIGONIA FITTONI, *Deshayes*, 1842.

Additional Synonymy.

1866. TRIGONIA FITTONI, *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), pp. 381, 386, pl. cxxviii, fig. 10.
1875. — — *Lycett*, p. 132, pl. xxiii, figs. 4, 5.
1897. — — *R. B. Newton.* Proc. Dorset Nat. Hist. and Antiq. Field Club, vol. xviii, p. 96, pl. iii, fig. 15.

Types.—In the École des Mines, Paris, from the Albian of Le Gaty, Epothémont, etc. (Aube). The specimens figured by Lycett are in the Museum of Practical Geology, and in the Wiltshire Collection, Woodwardian Museum. The example figured by Newton is in the British Museum.

Distribution.—Gault (zone i) of Folkestone. Zone of *Hoplites interruptus* of Okeford Fitzpaine.

TRIGONIA COSTIGERA, *Lycett*, 1879.

1879. *Lycett*, p. 205, pl. xli, fig. 17.

Type.—In the Museum of Practical Geology. This is the only specimen seen; it is very imperfectly preserved.

Distribution.—Cenomanian (Meÿer's Bed 10) of Dunscombe.

TRIGONIA PENNATA, *Sowerby*, 1819.

Additional Synonymy.

1828. TRIGONIA PENNATA, *Defrance.* Dict. Sciences nat., vol. lv, p. 297.
1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 387.
1875. — — *Lycett*, p. 133, pl. xxiv, figs. 4, 5; pl. xxxvii, fig. 4.

Types.—In the British Museum—from near Teignmouth. The specimens figured by Lycett are in Mr. Vicary's Collection, and in the British Museum (Cunnington Collection).

Distribution.—Cenomanian (Meyer's Beds 10 and 11) of Dunscombe. Greensand of Haldon, Teignmouth, and Kingskerswell.

TRIGONIA SULCATARIA, *Lamarck.*

Additional Synonymy.

? 1840. TRIGONIA SULCATARIA, *H. B. Geinitz.* Char. d. Schicht. u. Petref. sächsisch. Kreidegeb., pt. 2, pp. 54, x, pl. xxi, fig. 3.
? 1846. — — *Geinitz.* Grundriss der Verstein., p. 444.
? 1846. — — *A. E. Reuss.* Die Verstein der böhm. Kreideformat., pt. 2, p. 5.
1850. — — *H. B. Geinitz.* Das Quadersandst. oder Kreidegeb. in Deutschland, p. 158.
1850. — — *G. P. Deshayes.* Traité Elém. de Conchyl., vol. ii, p. 259, pl. xxxiii, fig. 10.
1866. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 387.
1867. — — *E. Guéranger.* Album Paléont. de la Sarthe, p. 14, pl. xviii, fig. 6.
? 1873. — — *H. B. Geinitz.* Das Elbthalgeb. in Sachsen. (Palæontographica, vol. xx), pt. 1, p. 224, pl. xlix, figs. 13, 14.
1875. — — *Lycett,* p. 135, pl. xxvi, fig. 8; pl. xxviii, fig. 3.

Remarks.—*T. maudensis,* Whiteaves,[1] *T. diversicostata,* Whiteaves,[2] and *T. Buchi,* Geinitz,[3] are allied forms; and so also is probably *T. subovalis,* Jimbo.[4]

Types.—The specimens figured by Lycett are in Mr. Vicary's Collection.

Distribution.—Cenomanian of Dunscombe. Greensand of Haldon and Kingskerswell.

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[1] 'Mesozoic Fossils,' vol. i, pt. 3 ('Geol. and Nat. Hist. Survey Canada,' 1884), p. 230, pl. xxxi, fig. 2.

[2] Ibid., pt. 1 (1876), p. 68, pl. x, fig. 1.

[3] 'Das Elbthalgeb. in Sachsen,' pt. 1 (1873), p. 225, pl. xlix, figs. 15, 16.

[4] "Kreideformat. von Hokkaido" ('Palæont. Abhandl.,' vol. vi, 1894), p. 42, pl. viii, fig. 5.

TRIGONIA CUNNINGTONI, *Lycett*, 1875.

1875. *Lycett*, p. 146, pl. xxiii, fig. 11.

Type.—British Museum (Cunnington Collection).
Distribution.—Upper Greensand of Devizes.

Section 6.—BYSSIFERÆ.

TRIGONIA CARINATA, *Agassiz*, 1840.

Additional Synonymy.

1858.	TRIGONIA	CARINATA,	*J. Vilanova-y-Piera.*	Mém. Geog.-agric. de Castellon, pl. iii, fig. 19.
1861.	—	—	*P. de Loriol.*	Invert. Foss. du Mt. Salève, p. 74.
1865.	—	—	*H. Coquand.*	Mon. Aptien de l'Espagne, p. 135.
1866.	—	—	*F. J. Pictet and G. Campiche.*	Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 365.
1877.	—	—	*Lycett*,	p. 179, pl. xxxv, figs. 3—6.
1896.	—	—	*A. Wollemann.*	Zeitschr. d. deutsch. geol. Gesellsch., vol. xlviii, p. 846.
1900.	—	—	—	Die Biv. und Gastrop. deutsch. u. holländ. Neoc. (Abhandl. d. k. preussisch, geol. Land. N. F., pt. 31), p. 86, pl. iv, figs. 6, 7.

Remarks.—*T. subcarinata*, Ébray,[1] (= *T. Heva*, Dollfuss) is an allied form, but with fewer costæ.

Types.—From the Neocomian of Hauterive. The specimens figured by Lycett are in the Museum of Practical Geology.

Distribution.—*Perna*-bed of Atherfield and Sandown. Hythe Beds of Hythe, Lympne, and Maidstone. Upper Greensand of Ventnor, Blackdown, Melbury (near Shaftesbury), and Potterne.

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[1] 'Études géol. sur le départ. de la Nièvre' (1858), p. 200; Dollfuss, 'Bull. Soc. géol. France,' ser. 2, vol. xx (1863), p. 220, pl. ii; De Loriol, 'Gault de Cosne' (1882), p. 97, pl. xii, figs. 8—10.

Family—MYTILIDÆ, *Lamarck*.

Genus—MYTILUS, *Linnæus*, 1758.

('Syst. Nat., ed. 10, p. 704.')

MYTILUS INÆQUIVALVIS, *Sowerby*, 1836. Plate XV, figs. 7 *a*—*d*.

1836. MYTILUS INÆQUIVALVIS, *J. de C. Sowerby*. Trans. Geol. Soc., ser. 2, vol. iv, pp. 241, 342, pl. xvii, fig. 16 (*non* Deshayes, 1838).
1854. — — *J. Morris*. Cat. Brit. Foss., ed. 2, p. 215.

Description.—Shell slightly inequivalve, compressed, triangular, expanded and rounded posteriorly; edges sharp except at the anterior part of the ventral margin. Dorsal margin slightly curved, ventral nearly straight. Umbones slightly curved, pointed; no carina; greatest convexity between the umbones and the postero-ventral extremity. Surface smooth except for faintly marked growth-lines.

***Measurements*:**

	(1)	(2)
Umbo to postero-ventral extremity	42	31 mm.
Height (at right angles to greatest length)	24	19 „
Thickness	13·5	11 „

(1), the Type; (2), in the British Museum.

Affinities.—This species seems to approach *M. Gallicnnei*, d'Orbigny,[1] but is more compressed near the postero-ventral edge, less regular in outline, and without ornamentation near the ventral border.

Type.—In the Bristol Museum. The only other specimen seen is in the British Museum.

Distribution.—Blackdown Greensand.

MYTILUS, sp., *cf.* TORNACENSIS, *d'Archiac*, 1847.

1847. MYTILUS TORNACENSIS, *A. d'Archiac*. Mém. Soc. géol. France, ser. 2 vol. ii, p. 307, pl. xv, fig. 3.
1847. — HAINOENSIS, *P. de Ryckholt*. Elucubrat. paléont. (not seen).

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[1] 'Pal. Franç. Terr. Crét.,' vol. iii (1844), p. 273, pl. cccxxxix, figs. 1, 2. See also Geinitz, "Das Elbthalgeb. in Sachsen" ('Palæontographica,' vol. xx), pt. 1 (1873), p. 213, pl. xlviii, figs. 1—3.

1852. **Mytilus tornacensis**, *P. de Ryckholt.* Mélanges Paléont., pt. 1 (Mém. cour. et Mém. des Sav. étrangers vol. xxiv), p. 150, pl. ix, fig. 7.
1871. — — *F. Stoliczka.* Palæont. Indica, Cret. Fauna S. India vol. iii, p. 374.
1883. **Modiola**, sp. nov., *W. Keeping.* Foss., &c., Neoc., Upware and Brickhill, p. 118.

Remarks.—A single specimen described, but not named, by W. Keeping agrees closely with *M. tornacensis*, d'Archiac. The greater part of the shell has unfortunately disappeared except ventrally to the carina, where the characteristic crimp-like ornamentation is seen, but is rather finer than in Belgian specimens.

D'Orbigny[1] and some other authors have considered *M. tornacensis* to be identical with *M. Galliennei*, d'Orbigny, but the two forms seem to me quite distinct. The former (of which I have one specimen from Tournay, sent me by M. Piret, and also figures of a specimen in the Brussels Museum, kindly made by M. Rutot) is distinguished from the latter by (1) the more prominent, ridge-like, regular growth-lines;[2] (2) the presence of the crimp-like ornamentation near the dorsal margin as well as ventrally; (3) the less pointed umbonal region; (4) the curvature of the carina. I am doubtful whether this species should be referred to *Mytilus.*

Type.—From the Tourtia of Tournay.

Distribution.—Lower Greensand of Upware.

Genus—Modiola, *Lamarck*, 1799.

('Mém. Soc. Hist. Nat. Paris,' p. 87.)

Modiola æqualis, *Sowerby*, 1818. Plate XV, figs. 8 *a*—*c*, 9—14.

1818. **Modiola æqualis**, *J. Sowerby.* Min. Conch., vol. iii, p. 18, pl. ccx, fig. 2.
? 1842. — **bipartita**, *A. Leymerie.* Mém. Soc. géol. France, vol. v, p. 26, pl. ix, fig. 8 (non *bipartita*, Sowerby).
1844. **Mytilus æqualis**, *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 265, pl. cccxxxvii, figs. 3, 4.
1845. — (**Modiolus**) **æqualis**, *E. Forbes.* Quart. Journ. Geol. Soc., vol. i, p. 248.
1850. — **æqualis**, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 81.
1854. **Modiola æqualis**, *J. Morris.* Cat. Brit. Foss., ed. 2, p. 210.
1855. **Mytilus æqualis**, *G. Cotteau.* Moll. Foss. de l'Yonne, p. 93.

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[1] 'Prod. de Pal.,' vol. ii (1850), p. 165.

[2] In this respect d'Archiac's fig. 3 is not satisfactory; it was probably drawn from a worn specimen.

1858. MYTILUS ÆQUALIS, *F. J. Pictet and E. Renevier.* Foss. Terr. Aptien (Matér. Pal. Suisse, ser. 1), p. 116, pl. xvi, fig. 2.
1865. — — *H. Coquand.* Mon. Aptien de l'Espagne, p. 143.
1868. — — *E. Eichwald.* Lethæa Rossica vol. ii, p. 531.
1867. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), pp. 496, 507.
1883. MODIOLA OBESA, *W. Keeping.* Foss., &c., Neoc. Upware and Brickhill, p. 117, pl. vi, fig. 3.

? Non 1846. — ÆQUALIS, *A. E. Reuss.* Die Verstein. der böhm. Kreideformat., pt. 2, p. 15, pl. xxxiii, fig. 10.
— 1866. — — *K. A. Zittel.* Die Bivalv. der Gosaugeb, pt. 2 (Denkschr. d. k. Akad. Wissen. Math.-nat. Cl. Wien, vol. xxv), p. 80 (p. 4 of reprint), pl. xi, fig. 4.
— 1882. — — *J. Kiesow.* Schrift. der nat. Gesell. in Danzig, vol. v, p. 240.
? — 1885. — — *F. Nötling.* Die Fauna der baltisch. Cenom. (Palæont. Abhandl., vol. ii), p. 24, pl. iv, fig. 1.

Description.—Shell ovate-oblong, rather short, rounded at the ends, convex, compressed posteriorly. Dorsal and ventral margins usually nearly parallel. Umbones obtuse, not terminal. Carina absent or very indistinct; greatest convexity of valve between the umbo and the postero-ventral extremity. A slight mesial groove produces a small sinus near the middle of the ventral margin. Surface smooth except for the presence of small concentric ridges, which are best marked anteriorly and postero-dorsally.

Measurements :

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Length . .	29	28	27	22·5	22	21	15	mm.
Height . . .	14·5	15	12·5	12	11·5	10·5	9	„
Thickness . .	15	15	14	11	10	9·5	9	„

(1—7) all from the Crackers of Atherfield.

Affinities.—The young forms of *M. reversa*, Sowerby, are distinguished from this species by the greater obliquity of their ventral margins. *M. Fittoni*, d'Orbigny,[1] appears to differ from *M. æqualis* in the presence of a distinct carina with radial striæ in front of it, and also in its greater length.

Forbes and Morris considered that *M. Archiaci*, Leymerie,[2] and *M. bipartita*, Leymerie, *non* Sowerby, were identical with *M. æqualis*. Some of our specimens agree very closely with Leymerie's figures of the latter, but with the former the agreement is not quite so satisfactory; the figures given by d'Orbigny,[3] and by

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[1] 'Prodr. de Pal.,' vol. ii (1850), p. 81.

[2] 'Mém. Soc. géol. France,' vol. v (1842), p. 8, pl. x, fig. 2.

[3] 'Pal. Franç. Terr. Crét.,' vol. iii (1845), p. 291, pl. cccxliv, figs. 10—12.

Pictet and Campiche,[1] show a more elongate shell; the species is referred by these authors to *Lithodomus*.

M. culter, Wollemann,[2] from the Hils-conglomerate of Brunswick, is closely allied; it appears to differ chiefly in having a more angular outline and a distinct carina.

Young specimens of *M. æqualis* are similar in form to *M. matronensis*, d'Orbigny,[3] but apparently somewhat longer.

I am unable to distinguish *M. obesa*, Keeping (from Upware), from *M. æqualis*; its somewhat greater inflation is, I think, due to crushing.

Types.—In the British Museum—internal casts from the Sandgate Beds of Parham Park. The type of *M. obesa*, Keeping, is in the Woodwardian Museum.

Distribution.—*Perna*-bed, Crackers, and Beds 35 and 36 (Fitton) of Atherfield. *Perna*-bed of Redcliff. Ferruginous Sands of Shanklin. Atherfield Beds of Sevenoaks and Peasmarsh. Hythe Beds of Maidstone. Sandgate Beds of Parham Park. Lower Greensand of Upware.

MODIOLA REVERSA, *Sowerby*, 1836. Plate XV, figs. 15, 16, 17 *a*, *b*, 18 *a*—*c*; Plate XVI, figs. 1, 2 *a*, *b*, 3.

1836. MODIOLA REVERSA, *J. de C. Sowerby.* Trans. Geol. Soc., ser. 2, vol. iv, pp. 241, 342, pl. xvii, fig. 13.

? 1842. — LÆVIGATA, *H. B. Geinitz.* Char. der Schicht. und Petref. des sächs.-böhm. Kreidegeb., pt. 3, p. 78, pl. xx, fig. 35.

? 1843. — REVERSA, *H. B. Geinitz.* Die Verstein. von Kieslingswalda, p. 15, pl. iii, fig. 11.

1844. MYTILUS SEMIRADIATUS, *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 277, pl. cccxli, figs. 1, 2.

1850. MODIOLA REVERSA, *H. B. Geinitz.* Das Quadersandst. oder Kreidegeb. in Deutschland, p. 168 (*partim*).

1850. MITYLUS REVERSUS, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 165.

1854. MODIOLA REVERSA, *J. Morris.* Cat. Brit. Foss., ed. 2, p. 211.

1867. MYTILUS (MODIOLA) REVERSUS, *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 510.

1868. — REVERSUS, *A. Briart and F. L. Cornet.* Descript. Min. géol. et Pal. de la Meule de Bracquegnies (Mém. cour. et Mém. des Sav. étrangers, vol. xxxiv), p. 53, pl. iv, figs. 9, 10.

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[1] "Foss. Terr. Crét. Ste. Croix" ('Mater. Pal. Suisse,' ser. 3, 1866), pp. 517, 524, pl. cxxxiv fig. 8.

[2] 'Zeitschr. d. deutsch. geol. Gesellsch.,' vol. xlviii (1896), p. 843, pl. xxi, f. 4; and 'Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc.' (1900), p. 65.

[3] 'Pal. Franç. Terr. Crét., vol. iii (1844), p. 269, pl. cccxxxvii, figs. 14—16.

? 1873. MODIOLA REVERSA, var., *H. B. Geinitz.* Das Elbthalgeb. in Sachsen (Palæontographica, vol. xx), pt. 1, p. 216, pl. xlviii, fig. 9.

Non 1844. MYTILUS REVERSUS, *A. d'Orbigny.* Pal. Franç. Terr. Cret., vol. iii, p. 264, pl. cccxxxvii, figs. 1, 2.

? 1846. MODIOLA REVERSA, *A. E. Reuss.* Die Verstein. der böhm. Kreideformat., pt. 2, p. 15, pl. xxxiii, fig. 9.

Description.—Shell elongate-oval, extremities rounded; median part of shell—from the umbo to the posterior extremity—inflated and slightly curved; dorsal part compressed and somewhat extended. Ventral to the inflated part is a shallow depression. Hinge margin forms an obtuse angle with the oblique and slightly convex posterior margin. Ventral border sinuous. Umbones obtuse; no carina. Ornamentation consists of concentric ridges, often sharply marked, sometimes discontinuous and rather irregular; between these are seen, in some specimens, much finer ridges. A bundle of fine radial ribs extends from the umbo to the ventral sinuosity and occupies the greater part of the shallow depression; occasionally fine close-set radial lines are seen on other parts of the shell.

Measurements:

	(1)	(2)	(3)	(4)	(5)	(6)	
Length	71	70	58	54	34	21	mm.
Greatest diameter perpendicular to length . . .	29	30	26	22	15	12	„
Thickness	27	—	22	21	—	—	„

(1—6) all from Blackdown.

Affinities.—The form figured by d'Orbigny as *M. reversus* (Sowerby), but afterwards separated as *M. Fittoni,* d'Orbigny,[1] appears to differ from Sowerby's species in the possession of a distinct carina, and in having the umbones placed less anteriorly.

M. typica (Forbes),[2] especially as represented by the forms from Gosau, is closely allied to *M. reversa.*

M. albensis (d'Orbigny)[3] is very near to *M. reversa*, but is perhaps distinguished by the somewhat longer and less curved anterior margin.

For the relation of this form to *M. ligeriensis* (d'Orbigny) see below.

Type.—In the Bristol Museum, from Blackdown.

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[1] For the synonymy of this species see Pictet and Campiche, 'Foss. Terr. Crét. Ste. Croix' (Matér. Pal. Suisse, ser. 4, 1867), p. 495.

[2] 'Trans. Geol. Soc.,' ser. 2, vol. vii (1846), p. 152, pl. xiv, fig. 4; Zittel, "Die Bivalv. der Gosaugeb." ('Denkschr. d. k. Akad. Wissensch. Math.-nat. Classe,' vol. xxv, 1866), pt. 2, p. 78 (p. 2 of reprint), pl. xi, fig. 5; Stoliczka, 'Cret. Fauna S. India,' vol. iii (1871), p. 377, pl. xxiii, figs. 12—15.

[3] Pictet and Campiche, op. cit., p. 504, pl. cxxxiv, fig. 1.

Distribution.—Greensand of Blackdown. Greensand (chert beds) of Woodlands Covert, Great Haldon. Upper Greensand of Black Ven and Devizes. Cenomanian (Meÿer's Bed 12) of Dunscombe. ? Gault of Black Ven.

MODIOLA LIGERIENSIS (*d'Orbigny*), 1844. Plate XVI, figs. 4 *a*, *b*, 5 *a*, *b*, 6.

1844. MYTILUS LIGERIENSIS, *A. d'Orbigny.* Pal. Franç. Terr. Crét., vol. iii, p. 274, pl. cccxl, figs. 1, 2.
1850. — — — Prodr. de Pal., vol. ii, p. 165.
1867. — — *E. Guéranger.* Album Paléont. de la Sarthe, p. 17, pl. xxii, figs. 2—4.
1867. MODIOLA LIGERIENSIS, *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 509.
? 1876. — — *D. Brauns.* Zeitschr. f. d. gesammt. Naturwiss., vol. xlvi, p. 374.
? 1883. — TYPICA, *A. Fritsch.* Stud. im Gebiete der böhm. Kreideformat., iii. Die Iserschichten, p. 106, fig. 73.

? Non 1846. MYTILUS (MODIOLA) LIGERIENSIS, *A. E. Reuss.* Die Verstein. der böhm. Kreideformat., pt. 2, p. 16, pl. xxxiii, fig. 3.

Measurements:

	(1)	(2)
Length	89	60 mm.
Greatest height (perpendicular to length)	40	25 „
Thickness	34	24 „

(1) and (2) from the *Perna*-bed of Atherfield.

Affinities.—This species agrees with *M. reversa*, Sowerby, and seems to be distinguished only by the crimp-like ornament in the spaces between the ribs; this is usually best developed on the dorsal and postero-ventral parts of the valves, and seems always to be absent on the anterior region. The specimens of *M. reversa* from Blackdown do not show that ornament,[1] and its absence can scarcely be explained by imperfect preservation, since other finer ornament is clearly shown on some specimens. On the other hand, the possibility of the two species being identical is supported by the great variability in the development of the crimp-like ornament in *M. ligeriensis*. On some specimens from the Cenomanian of Orbiquet it is very faint, but on one from Le Mans (preserved in the École des Mines, Paris) the crimp-ornament is stronger and more continuous than the concentric ornament.

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[1] One specimen seems to show a very faint trace of it near the hinge-margin.

Distribution.—*Perna*-bed of Atherfield. Upper Greensand of Potterne. Chloritic Marl of Warminster. ? Cenomanian of Wilmington (fragment only seen).

Modiola rugosa, *Römer*, 1836.

1836. Modiola rugosa, *F. A. Römer*. Die Verstein. nord-deutsch. Oolithengeb., p. 93, pl. v, f. 10.
1841. — — — Die Verstein. nord-deutsch. Kreidegeb., p. 67.
1850. Mitylus subrugosus, *A. d'Orbigny*. Prodr. de Pal., vol. ii, p. 81.
1867. Mytilus (Modiola) rugosus, *F. J. Pictet and G. Campiche*. Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 508.
1896. Modiola rugosa, *A. Wollemann*. Zeitschr. d. deutsch. geol. Gesellsch., vol. xlviii, p. 845.
1900. — — — Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc. (Abhandl. d. k. preuss. geol. Land., N. F., pt. 31), p. 64.

Remarks.—A specimen 45 mm. long, with the umbones broken, is in the Leckenby Collection (Woodwardian Museum), and belongs, I think, to this species.

Type.—From the Hilsthon of the Elligser Brink.

Distribution.—Crackers of Atherfield.

Modiola subsimplex (*d'Orbigny*), 1850. Plate XVI, figs. 7, 8, 9 *a*, *b*, 10 *a*, *b*.

1842. Modiola simplex, *G. P. Deshayes*. In A. Leymerie, Mém. Soc. géol. France, vol. v, pp. 8, 26, pl. vii, fig. 8 (non ***Mytilus simplex***, Defrance, 1824; Passy, 1832).
1844. Mytilus — *A. d'Orbigny*. Pal. Franç. Terr. Crét., vol. iii, p. 269, pl. cccxxxviii, figs. 1—4.
1845. Mytilus (Modiolus) simplex, *E. Forbes*. Quart. Journ. Geol. Soc., vol. i, p. 248.
1850. Mitylus subsimplex, *A. d'Orbigny*. Prodr. de Pal., vol. ii, p. 81.
1852. Mytilus gurgitis, *F. J. Pictet and W. Roux*. Moll. Foss. Grès verts de Genève, pp. 481, 551, pl. xl, fig. 2.
1854. Modiola simplex, *J. Morris*. Cat. Brit. Foss., ed. 2, p. 211.
1855. Mytilus subsimplex, *G. Cotteau*. Moll. Foss. de l'Yonne, p. 94.
1858. — — *F. J. Pictet and E. Renevier*. Foss. Terr. Aptien (Matér. Pal. Suisse, ser. 1), p. 114, pl. xvi, fig. 3.
1861. — — *P. de Loriol*. Anim. Invert. Foss. Mt. Salève, p. 92, pl. xi, fig. 9.

1865. **Mytilus subsimplex**, *H. Coquand.* Mon. Aptien de l'Espagne, p. 143.
1867. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), pp. 493, 507.
1882. **Modiola sub-simplex**, *P. de Loriol.* Gault de Cosne (Mém. Soc. Pal. Suisse, vol. ix), p. 81, pl. ix, fig. 17.
1884. **Mytilus simplex**, *O. Weerth.* Die Fauna d. Neoc. im Teutoburg. Walde (Palæont. Abhandl., vol. ii), p. 47.
1895. — — *G. Maas.* Zeitschr. der deutsch. geol. Gesellsch., vol. xlvii, p. 266.
1896. **Modiola simplex**, *A. Wollemann.* Zeitschr. der deutsch. geol. Gesellsch., vol. xlviii, p. 844.
1897. **Mytilus** — *R. B. Newton.* Proc. Dorset Nat. Hist. and Antiq. Field Club, vol. xviii, p. 89, pl. iii, fig. 13.
1900. **Modiola subsimplex**, *A. Wollemann.* Die Biv. u. Gastrop. d. deutsch. u. holländ. Neocoms. (Abhandl. d. k. preussisch. geol. Land., N. F., pt. 31), p. 62.

Description.—Shell elongate, straight or curved, somewhat compressed. Anterior extremity narrow; posterior part somewhat expanded. Hinge-margin straight, long; posterior margin relatively short, curved, oblique; ventral margin concave. A rounded ridge extends from the umbo to the postero-ventral extremity; in front of this is a shallow depression. Surface smooth except for faint growth-lines.

Measurements:

	(1)	(2)	(3)	(4)	(5)	
Length (greatest)	51	48	44	34	30	mm.
Height (at right angles to greatest length)	16	15	14	13	11	„
Thickness	—	12·5	11	10	7·5	„

(1)—(5) all from the Crackers of Atherfield.

Affinities.—This species is very near to, and perhaps identical with, *M. siliqua*, Mathéron;[1] but the latter is said to have the anterior extremity more obtuse.

M. semiornatus, d'Orbigny, has the concentric ornament more pronounced on the dorsal part of the shell.

M. rectior, Wollemann,[2] from the Hils-conglomerate of Brunswick, is very closely related to *M. subsimplex*, but seems to differ in being less convex between the umbo and the posterior extremity, and in having the ventral margin straighter and the posterior more rounded.

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[1] 'Catal. Foss. Bouches-du-Rhone' (1842), p. 178, pl. xxviii, figs. 5, 6; d'Orbigny, 'Pal. Franç. Terr. Crét.,' vol. iii (1844), p. 274, pl. cccxxxix, figs. 3, 4; and 'Prodr. de Pal.' (1850), p. 165; Geinitz, 'Quadersandst. in Deutschland' (1850), p. 168, pl. x, fig. 14; Zittel, 'Die Bivalv. der Gosaugeb.,' pt. 2 (1866), p. 81 (p. 5 reprint), pl. xi, fig. 3; Pictet and Campiche, 'Foss. Terr. Crét. Ste. Croix (1867), p. 510; Geinitz, 'Das Elbthalgeb. in Sachsen,' pt. 1 (1873), p. 215, pl. xlvii, fig. 3, pt. 2, pl. xv, fig. 4; Böhm, "Kreidebild. Fürbergs," etc. ('Palæontographica,' vol. xxxviii, 1891), p. 81, pl. iii, fig. 29; Müller, "Mollusk. Untersen. Braunschweig und Ilsede" ('Abhandl. d. k. preuss. geol. Land.,' N. F., pt. 25, 1898), p. 46, pl. v, fig. 14.

[2] 'Zeitschr. d. deutsch. geol. Gesellsch.,' vol. xlviii (1896), p. 844, pl. xxi, f. 6; and 'Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc.' (1900), p. 63.

Types.—The type comes from the Neocomian of Ville-sur-Terre. The specimen referred to by Forbes is in the Museum of the Geological Society. The specimen figured by Newton is in the British Museum.

Distribution.—*Perna*-bed and Crackers of Atherfield. Atherfield Beds of Sevenoaks. Upper Greensand of Devizes. Gault of Folkestone, Black Ven, and Okeford Fitzpaine. ? Greensand of Blackdown.

Modiola flagellifera, *Forbes*, 1846. Plate XVII, figs. 1, 2.

? 1842. Inoceramus siliqua, *P. Mathéron.* Catal. Foss. Bouches-du-Rhône, p. 174, pl. xxv, fig. 6.
1846. Mytilus (Modiolus) flagelliferus. *E. Forbes.* Trans. Geol. Soc., ser. 2, vol. vii, p. 152, pl. xvi, fig. 9.
1850. Mitylus flagelliferus, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 247.
? 1863. Mytilus (Modiolus) flagelliferus, *D. Stur.* Jahrb. d. k.-k. geol. Reichsanst., vol. xiii, p. 55.
1866. Modiola flagellifera, *K. A. Zittel.* Die Bivalv. d. Gosaugeb. (Denkschr. d. k. Akad. der Wissensch. Math-nat. Classe, vol. xxv), pt. 2, p. 82 (p. 6 of reprint), pl. xii, fig. 2.
1867. — flagelliferus, *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 513.
1871. — flagellifera, *F. Stoliczka.* Pal. Indica, Cret. Fauna S. India, p. 379, pl. xxiv, figs. 1, 2.
? 1873. Mytilus (Modiola) flagellifera. *H. B. Geinitz.* Das Elbthalgeb. in Sachsen (Palæontographica, vol. xx), pt. 2, p. 55, pl. xv, fig. 5.
1897. Modiola flagellifera, *A. Fritsch.* Stud. im Geb. der böhm. Kreidef. vi, Die Chlomek. Schicht., p. 59, fig. 69.

Description.—Shell very elongate, slightly curved, compressed, with knife-like edges; somewhat enlarged posteriorly. Dorsal margin almost straight, and nearly parallel with the slightly concave ventral margin. Umbones obtuse, nearly terminal, with a faintly marked oblique carina extending to the postero-ventral extremity. Ornamentation consists of flagelliform ribs, which are broad near the dorsal margin, and are directed obliquely backwards. At about half their length they curve rapidly, diminish in size, bifurcate, and often have smaller ribs intercalated: the ribs taper at the carina, ventral to which the shell is marked with growth-lines only, or is nearly smooth.

Measurements :

	(1)	(2)
Length	77	102 mm.
Height	25	22 „

(1) and (2) from Devizes.

Affinities.—This species belongs to a section of *Modiola* characteristic of the Jurassic rocks, of which *M. Sowerbiana* (d'Orbigny) [= *M. plicata*, Sowerby], *M. perplicata* (Etallon), *M. Medus* (d'Orbigny), and *M. icaunensis* (de Loriol) are well-known representatives.

I have seen only three English examples, and these, although in the form of internal casts, seem to agree perfectly with the types of *M. flagellifera*, Forbes (from Pondicherry), with which I have compared them. Zittel has referred to this species a form found in the Gosau Beds, of which I have seen one specimen collected by Mr. H. Kynaston from Finstergraben, and now preserved in the Woodwardian Museum; this also agrees with the Forbes' types.

The specimen figured by Mathéron as *Inoceramus siliqua* is probably an imperfect example of this species. *Modiola Gillieroni* (Pictet and Campiche),[1] from the Valangian of Presle (near Bienne) and Cinquétral, appears to differ from *M. flagellifera* in having fewer ribs dorsally, and in the general absence of bifurcation as they curve on approaching the carina.

M. Baini, Sharpe,[2] from Sunday River (South Africa), apparently differs from *M. flagellifera* in having the ribs continued ventral to the carina, and perhaps also in having a more elongate shell.

M. Ebrayi, de Loriol,[3] is probably another related form, but at present is imperfectly known.

Types.—From the Valudayoor Group of Pondicherry, preserved in the Museum of the Geological Society of London (No. 10631); these are also figured by Stoliczka.

Distribution.—Upper Greensand of Devizes and Black Ven.

MODIOLA UNDULATA (*Forbes*). Plate XVII, fig. 3.

1845.	CYPRICARDIA? UNDULATA, *E. Forbes.*	Quart. Journ. Geol. Soc., vol. i, p. 242, pl. iii, fig. 1.
1848.	CYPRICARDIA UNDULATA, *H. G. Bronn.*	Index Palæont., vol. i, p. 387.

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[1] "Foss. Terr. Crét. Ste. Croix" ('Mater. Pal. Suisse,' ser. 4), 1867, p. 503, pl. cxxxiii, figs. 9, 10.

[2] 'Trans. Geol. Soc.,' ser. 2, vol. vii (1856), p. 193, pl. xxii, figs. 2, 3.

[3] "Faune du Gault de Cosne" ('Mém. Soc. Pal. Suisse,' vol. ix, 1882), p. 80, pl. ix, figs. 18—20 (especially fig. 20).

1850. Mitylus undulatus, *A. d'Orbigny*. Prodr. de Pal., vol. ii, p. 119.
1854. Cypricardia undulata, *J. Morris*. Cat. Brit. Foss., ed. 2, p. 129.
1867. Mytilus (Modiola) undulatus, *F. J. Pictet and G. Campiche*. Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 508.
1871. Modiola undulata, *F. Stoliczka*. Palæont. Indica, Cret. Fauna S. India, vol. iii, p. 372.

Description.—Shell moderately elongate, compressed, enlarged posteriorly. Dorsal margin nearly straight; ventral oblique; anterior rounded. Umbones not terminal, with a sharply marked curving carina extending to the postero-ventral extremity. From the dorsal margin broad ribs start and are directed posteriorly, afterwards curving to join the carina, where they end. Ventral to the carina the shell is marked by fine lines only.

Measurements :

Length	33 mm.
Height (at the posterior end)	18 „

Affinities.—This is distinguished from *M. flagellifera*, Forbes, and *M. Gillieroni* (Pictet and Campiche) by the shorter shell, the carina, the small curvature of the ribs, and the absence of bifurcation in them.

The generic position of this species cannot be stated with certainty, since the type specimen is the only example seen and the interior is unknown.

Type.—In the Museum of the Geological Society of London (No. 2088).

Distribution.—Atherfield Clay of Atherfield.

Sub-genus—Brachydontes, *Swainson*, 1840.

('Treatise on Malacology,' p. 384.)

Modiola (Brachydontes) Guerangeri ? (*d'Orbigny*), 1844. Plate XVII, figs. 4, 5 *a*—*c*.

1844. Mytilus Guerangeri, *A. d'Orbigny*. Pal. Franç. Terr. Crét., vol. iii, p. 282, pl. cccxlii, figs. 7—9.
1850. Mitylus — *d'Orbigny*. Prodr. de Pal., vol. ii, p. 166.
1862. Brachydontes Guerangeri, *J. G. Chenu*. Manuel de Conchyl., vol. ii, p. 154, fig. 762.
1867. Mytilus Guerangeri, *F. J. Pictet and G. Campiche*. Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 509.
1867. — — *E. Guéranger*. Album Paléont. de la Sarthe, p. 17, pl. xxiii, fig. 3.
1871. Modiola Guerangeri, *F Stoliczka*. Palæont. Indica, Cret. Fauna S. India, vol. iii, p. 373 (*Brachydontes*).

Remarks.—Two incomplete specimens in Mr. Meyer's collection agree with **M.** (*Brachydontes*) *Guerangeri*, from the Cenomanian of Le Mans, except in having finer ribs. Not having seen the type or other French specimens of *M. Guerangeri* I am unable to refer these examples definitely to that species. The ribbing on the ventral surface is clearly shown, and separates this form from *M. divaricata*, d'Orbigny.[1]

A specimen from the Greensand of Haldon, in Mr. Vicary's collection (pl. xvii, fig. 4), agrees with *M. Guerangeri*, especially with the example figured by Guéranger, except in the absence of the fine ribbing on the ventral surface; this difference may be due to imperfect preservation. The shell tapers more rapidly toward the umbones than in *M. divaricata*.

Distribution.—Greensand of Haldon. Cenomanian (Meyer's Beds 10 and 12) of Dunscombe.

MODIOLA (BRACHYDONTES) VECTIENSIS, sp. nov. Plate XVII, figs. 6 *a*, *b*, 7 *a*—*c*, 8.

Description.—Shell small, rather short, inflated, expanded, and compressed posteriorly, extremities rounded. Ventral margin with a sinus produced by a mesial depression. Umbones obtuse, not terminal. Ornamentation consists of many strong and somewhat irregular ribs, which cover the entire surface and generally bifurcate toward the margin of the valve.

Measurements:

	(1)	(2)	(3)	(4)	(5)	
Length	14	14	13·5	12·5	9	mm.
Height	7·5	8	8	8	5	„
Thickness	6	—	—	—	—	„

(1), (5) from the Crackers, Atherfield.
(2) from the *Perna*-bed, Redcliff.
(3) from the Atherfield Beds, Littleton Pit, near Guildford.
(4) from the Atherfield Beds, East Shalford.

Affinities.—The smaller forms of this species resemble *M. striato-costata* (d'Orbigny), but possess stronger and less regular ribs, and are without the concentric ribs.

M. morinicus[2] (de Loriol) is also similar, but has more regular ribs, which do not bifurcate, and some parts of the shell are without ribs.

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[1] 'Pal. Franç. Terr. Crét.,' vol. iii (1844), p. 275, pl. cccxl, figs. 3, 4; 'Prodr. de Pal.,' vol. ii (1850), p. 246; Pictet and Campiche, 'Foss. Terr. Crét. Ste. Croix' (1867), p. 511.

[2] De Loriol and Pellat, 'Portlandien de Boulogne-sur-Mer' ('Mém. Soc. Phys. et d'Hist. Nat. de Genève,' vol. xix, 1866), p. 91, pl. ix, fig. 4.

M. pedernalis, Römer,[1] is a larger species with finer ribs, and the anterior part of the shell nearly smooth.

Distribution.—*Perna*-bed of Redcliff. Crackers of Atherfield. Atherfield Beds of East Shalford, Peasmarsh, Sevenoaks, and (ferruginous nodules) Littleton Pit, near Guildford.

Modiola (Brachydontes) striato-costata (*d'Orbigny*), 1844. Plate XVII, figs. 9 *a*, *b*, 10 *a*, *b*, 11 *a*—*c*.

1844. Mytilus striato-costatus, *A. d'Orbigny*. Pal. Franç. Terr. Crét, vol. iii, p. 281, pl. ccxlii, figs. 4—6.
1848. Modiola striato costata, *H. G. Bronn*. Index Palæont., vol. i, p. 739.
1850. Mitylus striato-costatus, *A. d'Orbigny*. Prodr. de Pal., vol. ii, p. 166.
1867. Modiola striato-costatus, *F. J. Pictet and G. Campiche*. Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 510.
1871. — striato-costata, *F. Stoliczka*. Palæont. Indica, Cret. Fauna S. India, vol. iii, p. 373.

Description.—Shell small, oblong or ovate-oblong, short, inflated, somewhat expanded, and also rounded and compressed posteriorly, ventral margin slightly sinuous. Umbones not quite terminal. No carina; dorsal and ventral to a line between the umbones and the posterior extremity the valves are sharply compressed. Ornamentation consists of numerous fine radial ribs separated by narrow grooves and covering the entire surface; the ribs curve toward the dorsal margin. The radial ribs are crossed at intervals by concentric ridges.

Measurements:

	(1)	(2)	(3)	(4)	(5)	
Length	9	8	8	7	5·5	mm.
Height	6	5	4·5	4·25	3·5	„
Thickness . . .	—	4	4·75	5	—	„

(1) to (5) from Blackdown.

Affinities.—The relation of this species to *M. vectiensis* is given above. It seems to approach closely the form described by Pictet and Campiche[2] as *Lithodomus prestensis*.

Distribution.—Blackdown Greensand.

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[1] 'Die Kreidebild. von Texas' (1852), p. 53, pl. vii, fig. 11.

[2] "Foss. Terr. Crét. Ste. Croix" ('Matér. Pal. Suisse,' ser. 4, 1867), p. 522, pl. cxxxvi, figs. 2—4.

Modiola, sp.

1883. **Modiola pedernalis (?),** ***W. Keeping.*** **Foss., etc., Neoc. Upware and Brickhill, p. 117, pl. vi, fig. 2.**

A portion of a left valve with the surface abraded, from the Lower Greensand of Upware, was regarded by Keeping as probably *M. pedernalis*, Römer. The imperfect character of the specimen makes this reference very doubtful. The shell also resembles *M. autissiodorensis*, Cotteau, from the Portlandian.[1]

Genus—Crenella, *Brown*, 1827.

('Illust. Conch. Great Britain and Ireland,' pl. xxxi, figs. 12—14; ed. 2 (1844), p. 75, pl. xxiii, figs. 12—14.)

Crenella bella (*Sowerby*), 1836. Plate XVII, figs. 12 *a*, *b*, 13 *a*—*d*.

1836. Modiola bella, *J. de C. Sowerby.* Trans. Geol. Soc., ser. 2, vol. iv, pp. 113, 158, 336, pl. xi, fig. 9.
1844. Mytilus Cornuelianus, *A. d'Orbigny.* Pal. Franç. Terr. Crét, vol. iii, p. 268, pl. cccxxxvii, figs. 10—13.
1845. — (Modiolus) bellus, *E. Forbes.* Quart. Journ Geol. Soc., vol. i, p. 248.
1850. Mitylus Cornuelianus, *A. d'Orbigny.* Prodr. de Pal., vol. ii, p. 81.
1850. — bella, *d'Orbigny.* Ibid., p. 138.
1854. Modiola bella, *J. Morris.* Cat. Brit. Foss., ed. 2, p. 210.
1855. Mytilus Cornuelianus, *G. Cotteau.* Moll Foss. de l'Yonne, p. 93.
1858. — bellus, *F. J. Pictet and E. Renevier.* Foss. Terr. Aptien (Matér. Pal. Suisse, ser. 1), p. 113, pl. xv, fig. 10.
1867. — — *F. J. Pictet and G. Campiche.* Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 502.
1869. — — *P. de Loriol and V. Gilliéron.* Mon. de l'Étage Urgonien Infér. du Landeron (Mém. Soc. Helvet. Sci. Nat., vol. xxiii), p. 17, pl. i, fig. 15.
1871. Modiola bella, *F. Stoliczka.* Palæont. Indica, Cret. Fauna S. India, vol. iii, p. 372 (*? Crenella*).
1895. Mytilus Cornuelianus, *G. Maas.* Zeitschr. der deutsch. geol. Gesellsch., vol. xlvii, p. 266.
1896. Modiola Cornueliana, *A. Wollemann.* Zeitschr. der deutsch. geol. Gesellsch., vol. xlviii, p. 844.
1900. — bella, *A. Wollemann.* Die Biv. u. Gastrop. d. deutsch. u. holländ. Neocoms. (Abhandl. d. k. preuss. geol. Land., N. F., pt. 31), p. 69.

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[1] De Loriol and Cotteau, 'Mon. l'Étage Portlandien de l'Yonne' (1868), p. 189, pl. xii, fig. 8.

Description.—Shell subquadrate or oval, short, inflated—especially anteriorly and between the umbo and the postero-ventral extremity; on each side of this line the shell is compressed, and on the ventral side it is flattened. Hinge-margin relatively short; posterior margin curved, oblique; ventral long, nearly straight. Postero-ventral angle rounded. Umbo prominent, extending beyond the short anterior margin. Ornamentation consists of numerous fine regular radial ribs, crossed by finer concentric ribs, which are best marked on the dorsal part of the valves; also at intervals a few well-marked growth-lines.

Measurements:

	(1)	(2)	(3)	
Length . . .	16 .	14 .	13	mm.
Height . . .	11 .	9 .	8·5	„
Thickness . . .	13·5 . .	12·5.	11	„

(1—3) all from Atherfield.

Affinities.—This is distinguished from the other Cretaceous species[1] by its more quadrate outline. It may, perhaps, belong to the sub-genus *Rhomboidella*, Monterosato.

Types.—I have not seen the type; it came from the Hythe Beds, near Hythe.

Distribution.—*Perna*-bed of Atherfield and Redcliff. Crackers of Atherfield. Hythe Beds near Hythe, and near Maidstone.

Genus—LITHODOMUS, *Cuvier*, 1817.

('Le Règne Animal,' vol. ii, p. 471.)

LITHODOMUS RUGOSUS? *d'Orbigny*, 1845. Plate XVII, figs. 14 *a*, *b*.

1845. LITHODOMUS RUGOSUS, *A. d'Orbigny*. Pal. Franç. Terr. Crét., vol. iii, p. 294, pl. cccxlvi, figs. 1—3.
1850. — — — Prod. de Pal., vol. ii, p. 166.
1867. — — *E. Guéranger*. Album Paléont. de la Sarthe, p. 18, pl. xxiii, figs. 18—20.
1873. — — *H. B. Geinitz*. Das Elbthalgeb. in Sachsen (Palæontographica, vol. xx), pt. 1, p. 219, pl. li, figs. 24—26.

Description.—Shell elongate, oval, subcylindrical, dorsal and ventral margins nearly parallel, extremities rounded. Surface with strongly marked growth-lines. Umbones not terminal.

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[1] *C. concentrica*, Gabb; *C. elegantula*, Meek and Hayden; *C. sericea*, Conrad; *C. granulato-cancellata* (Römer); *C. inflata* (Müll.).

Measurements:

Length	28 mm.
Height	12 „

Affinities.—This species approaches *L. oblongus*, d'Orbigny, and *L. alpinus*, Zittel.

Remarks.—The three specimens seen are imperfectly preserved, and the radial ornament, described by d'Orbigny as occurring on the antero-ventral part of the valves, is not shown.

Distribution.—Cenomanian (Meÿer's Bed 10) of Dunscombe.

Family—DREISSENSIIDÆ, *Gray*.

Genus—Septifer, *C. A. Récluz*, 1848.

('Rev. Zool.,' p. 275.)

Septifer lineatus (*Sowerby*), 1836. Plate XVIII, figs. 1—12.

? 1820. Pinnites ungulatus, *E. F. Schlotheim*. Die Petrefactenkunde, p. 304.
1836. Modiola lineata, *J. de C. Sowerby*. Trans. Geol. Soc., ser. 2, vol. iv, pp. 129, 338, pl. xiv, fig. 2 (non *Mytilus lineatus*, Gmelin, 1789).
1839. — angusta, *F. A. Römer*. Die Verstein. norddeutsch. Oolithen-geb. Nachtrag, p. 33, pl. xviii, fig. 36 (non *M. angusta*, Deshayes, 1824).
? 1840. — Cottæ, *H. B. Geinitz*. Char. d. Schicht. u. Petref. des sächs Kreidegeb., pt. 2, p. 56, pl. x, fig. 5.
1841. — angusta, *F. A. Römer*. Die Verstein. norddeutsch. Kreidegeb., p. 66.
? 1841. Mytilus Cottæ, *Römer*. Ibid., p. 66, pl. viii, fig. 18.
1842. — Cuvieri, *P. Mathéron*. Cat. Foss. des Bouches-du-Rhone, p. 179, pl. xxviii, figs. 9, 10.
? 1843. — Cottæ, *H. B. Geinitz*. Die Verstein. von Kieslingswalda, p. 15.
1844. — lineatus, *A. d'Orbigny*. Pal. Franç. Terr. Crét., vol. iii, p. 266, pl. cccxxxvii, figs. 7—9.
? 1844. Modiola granulosa, *V. Potiez and A. Michaud*. Galerie des Moll., vol. ii, p. 132, pl. liv, fig. 10.
1845. Mytilus (Modiolus) asper, *E. Forbes* (non *Sowerby*). Quart. Journ. Geol. Soc., vol. i, p. 248.
? 1846. — Cottæ, *A. E. Reuss*. Die Verstein. der böhm. Kreideformat., pt. 2, p. 14, pl. xxxiii, fig. 4.
1848. Modiola lineata, *H. G. Bronn*. Index Palaeont., vol. i, p. 737.
1850. Mitylus sublineatus, *A. d'Orbigny*. Prodr. de Pal., vol. ii, pp. 81, 119.
? — — subangustus, *d'Orbigny*. Ibid., p. 81.

1850. Mitylus peregrinus, *d'Orbigny*. Ibid., p. 165.

-- — Cuvieri, *d'Orbigny*. Ibid., p. 246.

— — Cottæ, *d'Orbigny*. Ibid., p. 246.

— Modiola quadrata, *J. de C. Sowerby*. In F. Dixon, Geol. Sussex, p. 347 [p. 382 of ed. 2], pl. xxviii, fig. 13.

1852. Mytilus Cottæ, *P. de Ryckholt*. Mélanges Paléont., pt. 1 (Mém. cour. et Mém. des Sav. étrangers, vol. xxiv), p. 147.

? — — ciplyanus, *de Ryckholt*. Ibid., p. 152, pl. ix, figs. 12, 13.

1852. Modiola lineata, *C. G. Giebel*. Deutschl. Petref., p. 379 (*partim*).

1854. — — *J. Morris*. Cat. Brit. Foss., ed. 2, p. 210.

1852. Mytilus Orbignyanus, *F. J. Pictet and W. Roux*. Moll. Foss. Grès verts de Genève, p. 479, pl. xxxix, fig. 9.

1857. — sublineatus, *G. Cotteau*. Moll. Foss. de l'Yonne, p. 93.

1858. — — *F. J. Pictet and E. Renevier*. Foss. Terr. Aptien de la Perte du Rhône (Matér. Pal. Suisse, ser. 1), p. 111, pl. xv, figs. 8, 9.

1861. — — *P. de Loriol*. Anim. Invert. Foss. du Mt. Salève, p. 92.

1864. — spathulatus, *H. Seeley*. The Geologist, vol. vii, p. 53.

1865. — Cuvieri, *H. Coquand*. Mon. Aptien de l'Espagne, p. 142.

1867. — — *F. J. Pictet and G. Campiche*. Foss. Terr. Crét. Ste. Croix (Matér. Pal. Suisse, ser. 4), p. 491.

1867. — Cottæ, *Pictet and Campiche*. Ibid., p. 511.

1869. — Cuvieri, *P. de Loriol and V. Gilliéron*. Mon. de l'Étage Urgon. inf. de Landeron (Mém. Soc. Helvet. Sci. Nat., vol. xxiii), p. 16, pl. i, fig. 14.

? 1870. Modiola, cf. lineata, *F. Römer*. Geol. von Oberschles., p. 333.

1871. Mytilus Cottæ, *F. Stoliczka*. Palæont. Indica, Cret. Fauna S. India, vol. iii, p. 373, No. 56 (*Septifer?*).

1873. Modiola Cottæ, *H. B. Geinitz*. Das Elbthalgeb. in Sachsen (Palæontographica, vol. xx), pt. 1, p. 214, pl. xlviii, figs. 4—8.

1876. — (Septifer?) Cottæ, *D. Brauns*. Die Senon. Mergel des Salzberges (Zeitschr. f. d. gesammt. Naturwiss., vol. xlvi), p. 375.

1889. Mytilus Cottæ, *A. Fritsch*. Stud. im Geb. der böhm Kreidef. iv. Die Teplitzer Schicht., p. 79, fig. 66.

1896. Modiola angusta, *A. Wollemann*. Zeitschr. der deutsch. geol. Gesellsch., vol. xlviii, p. 844.

1897. — Cottæ, *R. Leonhard*. Die Fauna der Kreidef. von Oberschles. (Palæontographica, vol. xliv), p. 27.

1897. — — *H. Woods*. Quart. Journ. Geol. Soc., vol. liii, p. 380, pl. xxvii, figs. 9—12.

? 1898. Mytilus (Septifer) lineatus, *A. Fritsch*. Stud. im Geb. der böhm. Kreidef. vi. Die Chlomeker Schichten, p. 57, fig. 65.

1898. Septifer lineatus, *G. Müller*. Die Mollusk. Untersen. von Braunschweig und Ilsede, pt. 1 (Abh. d. k. preuss. geol. Land., N. F., pt. 25), p. 48, pl. vii, fig. 2.

1899. Modiola Cottæ, *A. Hennig.* Bihang till k. Svenska Vet.-Akad. Handl., vol. xxiv, p. 13, pl. i, figs. 16—19.
1900. — Cuvieri, *A. Wollemann.* Die Biv. u. Gastrop. d. deutsch. u. holländ. Neoc. (Abhandl. d. k. preuss. geol. Land., N. F., pt. 31), p. 68.

Non 1847. Mytilus lineatus, *J. Müller.* Petref. Aachen. Kreidef., pt. 1, p. 34.
— 1889. Septifer lineatus, *E. Holzapfel.* Die Mollusk. Aachen. Kreide (Palæontographica, vol. xxxv), p. 216, pl. xxv, figs. 10—13 (these figures are enlarged three times).

Description.—Shell thin, ovate-oblong, inflated, regularly convex from the umbo to the posterior extremity, more or less compressed at right angles to its greatest length (dorso-ventrally); slightly curved or occasionally straight. Dorsal margin slightly convex. Posterior extremity well rounded, a little expanded. Antero-ventral margin slightly concave, sometimes straight. Umbones small, curved, terminal. Carina faintly marked near the umbo, absent elsewhere. Antero-ventral face of the shell flattened or concave, postero-dorsal part regularly convex.

Ornamentation consists of fine but well-marked radial ribs, crossed by rather less distinct concentric ribs, giving a cancellate appearance; the radial ribs are serrate or granular where crossed by the concentric ribs. At intervals fairly strong growth-lines occur. An oval area below the umbones is without radial ribs, and shows only lines of growth.

Measurements :

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
Umbo to posterior extremity . .	49	42	42	41	37	34	32	29	36	28	mm.
Greatest diameter at right angles to preceding . . .	18	15	14	14·5	14	12	12	12	15	11	„
Thickness . .	29	25	23	26	22	20·5	15	15·5	21	16	„

(1—3, 6) from the Hythe Beds, Lympne.
(4) „ Chalk Marl, Chardstock.
(5) „ „ Kempstone Rocks.
(7) „ „ Dunscombe.
(8) „ „ Titherleigh.
(9, 10) „ Chalk Rock, Cuckhamsley.

Affinities.—The specimens figured by Geinitz as *M. Cottæ* in 'Das Elbthalgebirge in Sachsen' agree perfectly with our examples from the Cenomanian. The figures of *M. Cottæ* given by earlier authors appear to represent imperfect or crushed specimens, and I follow Geinitz, who was probably acquainted with the originals, in regarding them as the examples of *M. Cottæ.*

Modiola angusta, Römer, is considered by Wollemann to be identical with *M. lineata;* I have seen no examples of it.

Modiola quadrata, Sowerby, from the Upper Chalk, is, I believe, only a somewhat crushed example of this species, similar to the one figured on our Pl. XVIII, fig. 12.

Holzapfel considers that the forms from the Aachen Greensand, originally described by Müller as *Mytilus lineatus* and *M. scalaris*, should be referred to *M. lineatus*, Sowerby. The Aachen species is very variable, and I am greatly indebted to Prof. Holzapfel for the loan of six specimens which vary in their greatest length from 9·5 to 15 mm.[1] The Aachen shell is clearly distinct from our species; it is more curved, more irregular, smaller, and with the radial ribs more strongly marked and not crossed by concentric ribs, so that the cancellate appearance is not seen.

The form figured as *Mytilus ciplyanus* by de Ryckholt,[2] from Ciply and Maestricht, is perhaps a small example of *S. lineatus* (Sow.).

M. æquatoralis, Mayer-Eymar,[3] from Somaliland, is perhaps an allied form, but is imperfectly known at present.

Remarks.—The variations in this species consist chiefly in the amount of inflation and curvature of the valves, and in the flattening of the antero-ventral surface.

The examples from the Hythe Beds are usually larger, rather more inflated, and have the antero-ventral surface more flattened than those found in the Upper Greensand and Cenomanian. But all the different forms which the shell takes may be seen at all horizons, and from the examination of a large series of specimens I am convinced that the Lower Cretaceous forms cannot be separated from those of the Upper Cretaceous. The relative proportions of the valves of course change as age increases.

On account of the thinness of the shell the form of the valves has often become somewhat altered by pressure, and the shell itself—especially in specimens from the Hythe Beds—has often partly disappeared.

None of the specimens I have seen show the interior of the valves, but some of the internal casts give indications of the presence of an umbonal plate.

The name *M. Cottæ*, Römer, is adopted by Geinitz (1873) for this species, and *M. Cuvieri*, Mathéron, by Pictet and Campiche (1867), since the name *Mytilus lineatus* had been used by Gmelin in 1789 for another form, and *Modiola angusta* was also preoccupied by Deshayes (1824). D'Orbigny in 1850 substituted the name *sublineatus* for *lineatus*, Sow. If Sowerby's species be referred to *Septifer*, then his specific name may be retained.

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[1] It should be noticed that Holzapfel's figures of this species are enlarged three times.

[2] "Mélanges Paléont.," pt. 1 ('Mém. cour. et Mém. des Sav. étrangers,' vol. xxiv, 1852), p. 152, pl. ix, figs. 12, 13.

[3] 'Vierteljahrs. nat. Gesellsch. Zürich,' vol. xxxviii (1893), p. 254, pl. i, figs. 7, 8.

Measurements :

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Antero-ventral margin	47	45	42	40	38	35	35	34	33	30	26	26	25	24	22 mm.
Hinge-margin . .	20	22	24	20	20	20	16	20	18	16	13	12	15	15	12 mm.
Diameter from the middle of the carina (perpendicular) to posterior margin .	16	19	19	18	18	17	14	17	15	13	12	11	13	—	10 mm.
Thickness . . .	17	21	18	15	16	19	15	16	15	13	12	12	11·5	10	11 mm.

1, 3, 4, 5, 7, 8, 10, 14 from the Crackers, Atherfield.
2 „ *Perna*-bed, Atherfield.
6, 9, 11, 12, 13, 15 from Blackdown.

Affinities.—The presence of an umbonal plate shows that this species should be referred to the Dreissensiidæ. In the few specimens showing the interior I have found no trace of the anterior myophore (for the byssal muscle) which distinguishes *Congeria* from *Dreissensia*[1]—but further specimens to confirm the absence of this structure are desirable. From the Upper Eocene of the Paris basin, associated with marine fossils, M. Cossmann[2] has already described two species of *Dreissensia*, and that author confirms my reference of this Cretaceous species to the Dreissensiidæ.

This species may be allied to ***Mytilus tornacensis***, d'Archiac, from the Tourtia of Tournay, of which I have seen one specimen, sent me by M. Piret (see p. 91). That species, however, appears to differ from ours in having the carina at a greater distance from the antero-ventral border, also in the presence of more distinct and regular growth-lines with ridges or grooves at right angles to them, the ridges being best marked on the antero-ventral face of the shell. I do not know whether it possesses an umbonal plate or not. *M. subfalcatus*, d'Orbigny, from the Cenomanian, appears to have the concentric ribs more distinct on the carina than is usual in *M. lanceolatus*, but since this feature is seen in some specimens of the latter, and is generally present on the earlier parts of the shell, it can hardly be regarded as distinctive.

D'Orbigny considered that his *Mytilus Gallienne*i,[3] which in outline is similar to the larger examples of *M. lanceolatus*, was identical with *M. tornacensis*, d'Arch.

The forms from the Aachen Greensand described by Müller as *M. tegulatus*, Müll., *M. lanceolatus*, Sow., and *M. falcatus*, d'Orb., whilst referred by Holzapfel[4]

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[1] P. Oppenheim, 'Zeitschr. d. deutsch. geol. Gesellsch.,' vol. li (1891), p. 923, pl. li.

[2] 'Cat. Ill. Coq. Foss. Eoc. de Paris,' fascic. 2 (1887), p. 151.

[3] 'Pal. Franç. Terr. Crét.,' vol. iii (1844), p. 273, pl. cccxxxix, figs. 1, 2; 'Prodr. de Pal.,' vol. ii (1850), p. 165.

[4] "Die Mollusk. Aachen. Kreide" ('Palæontographica,' vol. xxxv, 1889), p. 218, pl. xxv, figs. 1—9. It should be noted that these figures are enlarged twice.

PLATE XV.

Genus—LIMOPSIS, *Sasso.*

FIGS.

1—4. *L. albiensis*, Woods. Gault, Folkestone. (P. 71.)

1. Zone iii. Left valve. Museum of Practical Geology. *a*, outline; *b*, dorsal outline; *c*, exterior × 3; *d*, interior × 4.
2. Zone vii. Right valve × 4. Same museum.
3. Right valve × 3. Same museum.
4. Zone ii. Part near umbo × 8. Same museum.

5, 6. *L.*, sp. Chalk Rock (*Reussianum* zone), Cuckhamsley. Montagu Smith Collection, Woodwardian Museum. (P. 72.)

5. Cast of interior of right valve. *a*, outline; *b*, dorsal outline; *c*, same × 2
6. Cast of interior of left valve. *a*, outline; *b*, dorsal outline; *c*, same × 2.

Genus—MYTILUS, *Linnæus.*

7. *M. inæquivalvis*, Sow. Greensand, Blackdown. The Type. Bristol Museum. *a*, right valve; *b*, left; *c*, antero-ventral; *d*, interior of right valve near the umbo × 2. (P. 91.)

Genus—MODIOLA, *Lamarck.*

8—14. *M. æqualis*, Sow. Crackers, Atherfield. (P. 92.)

8. Leckenby Collection, Woodwardian Museum. *a*, right valve, outline; *b*, same × 1½; *c*, dorsal of both valves.
9. Wiltshire Collection, Woodwardian Museum. Right valve.
10. Same Collection. Dorsal.

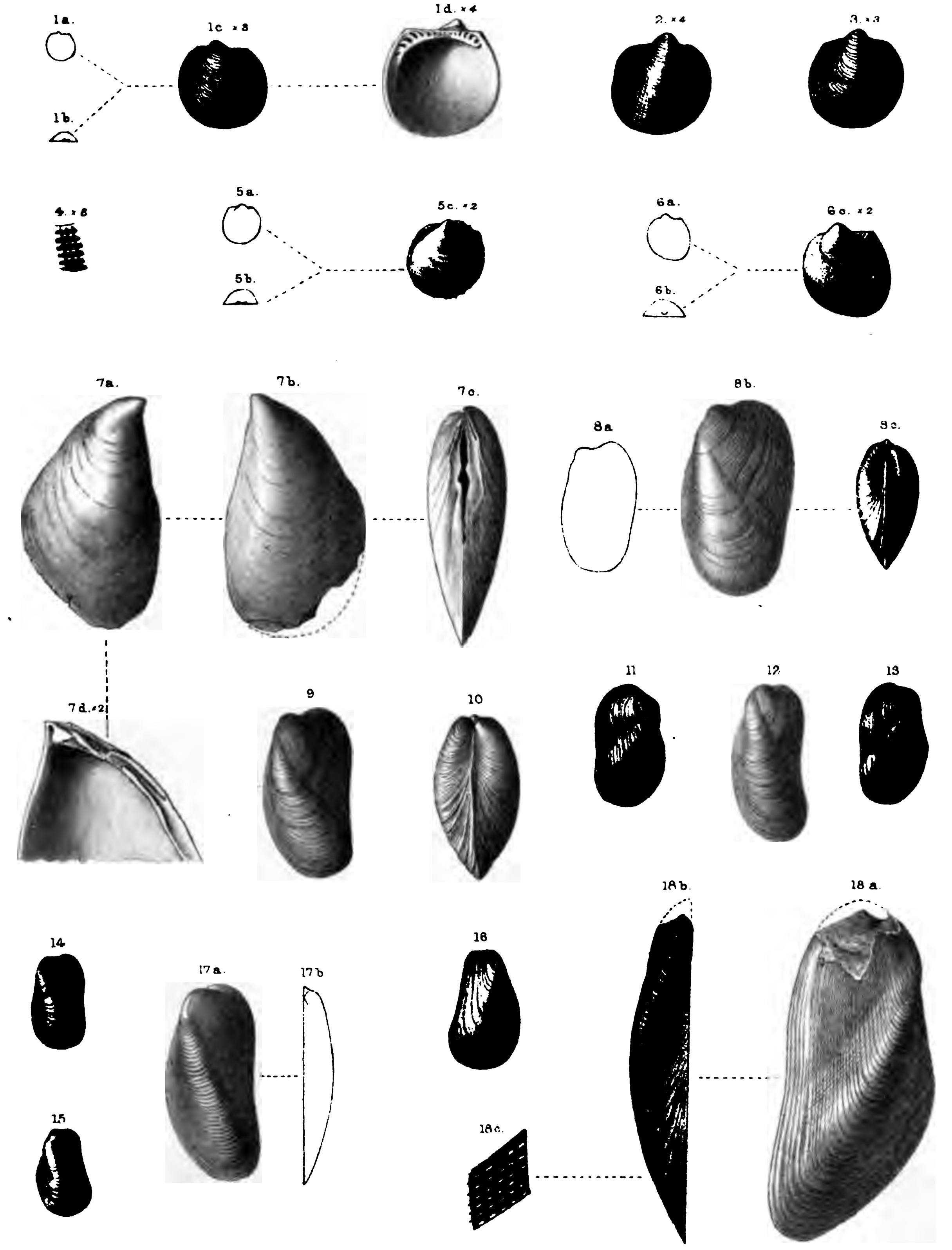
11—13. Same Collection. 11, left valve; 12, right valve (slightly crushed dorsoventrally); 13, left valve

14. Woodwardian Museum. Right valve.

15—18. *M. reversa*, Sow. Greensand, Blackdown. (P. 94.)

15. Wiltshire Collection. Right valve, young form.
16. Wiltshire Collection. Left valve, young form.
17. Wiltshire Collection. *a*, right valve; *b*, dorsal outline of same.
18. Woodwardian Museum. *a*, left valve; *b*, dorsal of same; *c*, portion just posterior to middle of the sulcus, showing radial ribs × 3.

PLATE XV.



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CRETACEOUS LAMELLIBRANCHIA.

PLATE XVI.

MODIOLA (*continued*).

FIGS.

1—3. *M. reversa*, Sow. Greensand, Blackdown. Wiltshire Collection, Woodwardian Museum. (P. 94.)

1. Right valve.
2. *a*, right valve; *b*, dorsal of both valves.
3. Ornamentation, a little posterior to the centre of the valve × 4.

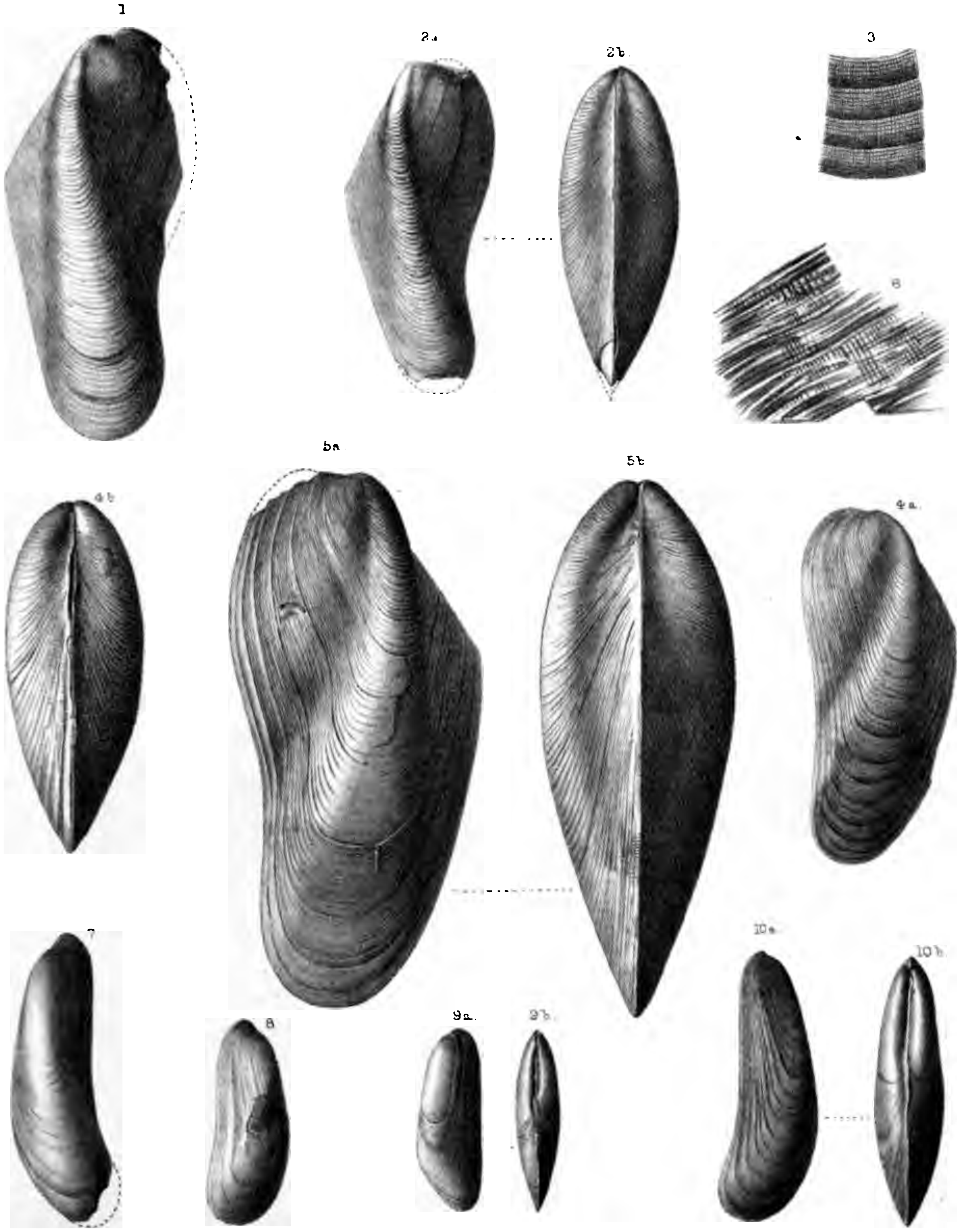
4—6. *M. ligeriensis* (d'Orb.). *Perna*-bed, Atherfield. (P. 96.)

4. Wiltshire Collection. *a*, left valve; *b*, dorsal of both valves.
5. Leckenby Collection. *a*, left valve; *b*, dorsal of both valves.
6. Leckenby Collection. Part adjoining middle of ventral edge × 2.

7—10. *M. subsimplex* (d'Orb.). Crackers, Atherfield. (P. 97.)

7. Leckenby Collection, Woodwardian Museum. Right valve.
8. Wiltshire Collection, Woodwardian Museum. Left valve.
9. Wiltshire Collection, Woodwardian Museum. *a*, right valve; *b*, dorsal of both valves.
10. Museum of the Geological Society of London (No. 2078). *a*, left valve; *b*, dorsal of both valves.

PLATE XVI.



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CRETACEOUS LAMELLIBRANCHIA.

PLATE XVII.

MODIOLA (*continued*).

FIGS.

1, 2. *M. flagellifera*, Forbes. (P. 99.)

1. Upper Greensand, Devizes. British Museum, No. 88,845. Right valve, slightly compressed dorso-ventrally.
2. Upper Greensand, Black Ven. Museum of Practical Geology, No. 6658. Dorsal view of both valves, somewhat compressed dorso-ventrally.

3. *M. undulata* (Forbes). Atherfield Clay, Atherfield. The Type. Museum of the Geological Society, No. 2088. Left valve. (P. 100.)

4, 5. *M.* (*Brachydontes*) *Guerangeri ?* (d'Orb.). (P. 101.)

4. Greensand, Haldon. Mr. W. Vicary's Collection. Left valve.
5. Cenomanian (Bed 10), Dunscombe. Mr. Meÿer's Collection. *a*, left valve; *b*, ventral of same; *c*, part of *a* × 2.

6—8. *M.* (*Brachydontes*) *vectiensis*, Woods. (P. 102.)

6. Crackers, Atherfield. Woodwardian Museum. *a*, outline of left valve; *b*, same × 2.
7. Atherfield Beds, Peasmarsh. Museum of the Geological Society, No. 2092. Right valve. *a*, outline; *b*, × 2; *c*, dorsal × 2.
8. Atherfield Beds, Littleton Pit, Guildford. Museum of Practical Geology. Right valve × 1½. Drawn from a wax cast of an external mould.

9—11. *M.* (*Brachydontes*) *striato-costata* (d'Orb.). Greensand, Blackdown. (P. 103.)

9. Mr. Meÿer's Collection. Left valve. *a*, outline; *b*, × 2.
10. Wiltshire Collection. Right valve. *a*, outline; *b*, × 3.
11. Mr. Meÿer's Collection. Left valve. *a*, outline; *b*, × 2; *c*, dorsal × 2.

Genus—CRENELLA, *Brown.*

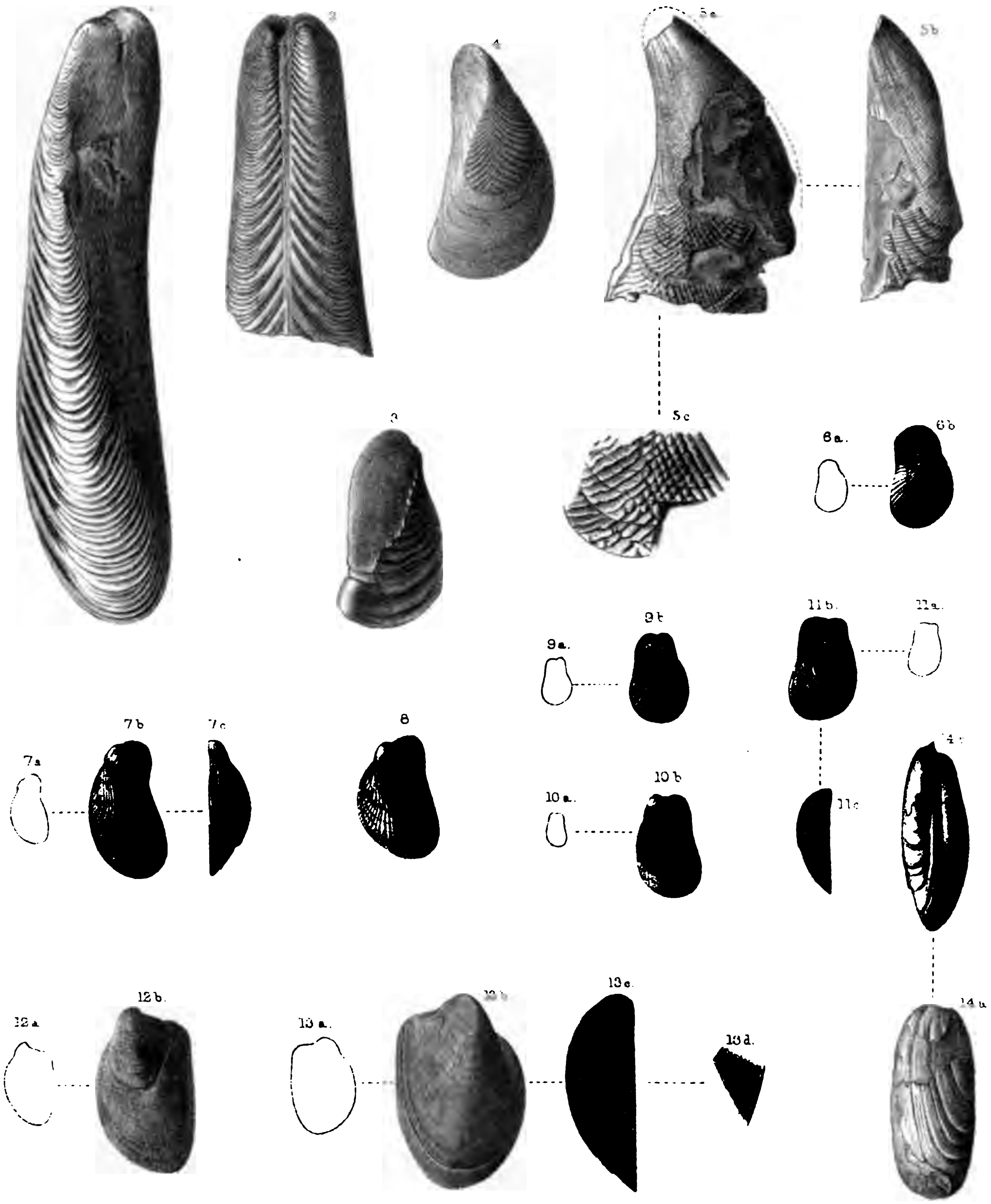
12, 13. *Crenella bella* (Sow.). Crackers, Atherfield. Wiltshire Collection. (P. 104 .)

12. Right valve. *a*, outline; *b*, × 2.
13. Left valve. *a*, outline; *b*, × 2; *c*, dorsal × 2; *d*, ornamentation from the dorsal surface × 6.

Genus—LITHODOMUS, *Cuvier.*

14. *Lithodomus rugosus* (*?*), d'Orb. Cenomanian (Bed 10), Dunscombe. Mr. Meÿer's Collection. *a*, left valve; *b*, dorsal. (P. 105.)

PLATE XVII.



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CRETACEOUS LAMELLIBRANCHIA.

PLATE XVIII.

Genus—SEPTIFER, *Récluz.*

FIGS.

1—12. *S. lineatus* (Sow.). (P. 106.)

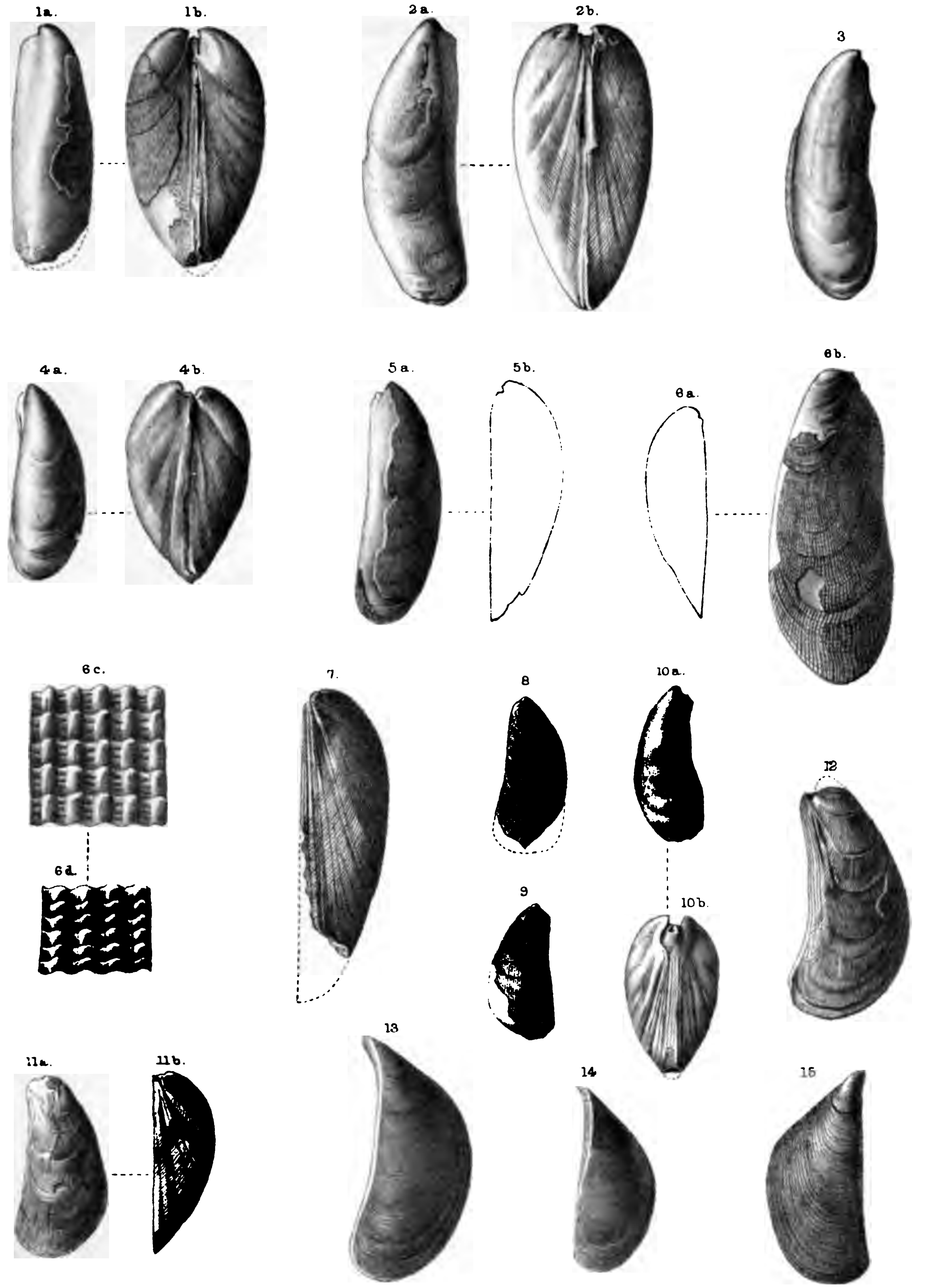
1. Hythe Beds, Lympne. Museum of Practical Geology, No. 6595. *a*, left valve; *b*, dorsal.
2. Same locality, &c., No. 6595. *a*, right; *b*, antero-ventral.
3. Hythe Beds, Hythe. Museum of the Geological Society. Right valve.
4. Hythe Beds, Lympne. Museum of Practical Geology, No. 6595. *a*, left valve; *b*, antero-ventral.
5. Chalk Marl, Chardstock. Museum of Practical Geology, No. 6596. *a*, left valve; *b*, antero-ventral outline.
6. Cenomanian (Bed 12), Kempstone Rocks (Sidmouth). Museum of Practical Geology, No. 6773. *a*, antero-ventral outline; *b*, right valve × 1½; *c*, ornamentation near the centre of the valve × 12; *d*, ornamentation near the posterior margin × 12.
7. Cenomanian (Bed 12), Axmouth. Mr. Meÿer's Collection. Antero-ventral of left valve.
8. Cenomanian (Bed 12), Dunscombe. Mr. Meÿer's Collection. Left valve.
9. Chalk Rock (*Reussianum* zone), Cuckhamsley. Montagu Smith Collection, Woodwardian Museum. Right valve. For figures of a larger example from this zone see 'Quart. Journ. Geol. Soc.,' vol. liii, 1897, pl. xxvii, figs. 11, 12.
10. Chalk Rock, Dullingham. Woodwardian Museum. Internal mould. *a*, right valve; *b*, antero-ventral.
11. Chalk Rock, Winchester. Mr. R. M. Brydone's Collection. *a*, left valve; *b*, antero-ventral. (Figured 'Quart. Journ. Geol. Soc.,' vol. liii, 1897, pl. xxvii, figs. 9, 10.)
12. Flint gravel (derived from Upper Chalk), near Ventnor. Left valve, somewhat flattened by crushing.

Genus—DREISSENSIA, *van Beneden.*

13—15. *D. lanceolata* (Sow.). Crackers, Atherfield. (P. 110.)

13. Left valve. Wiltshire Collection.
14. Left valve. Woodwardian Museum.
15. Right valve. Woodwardian Museum.

PLATE XVIII



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CRETACEOUS LAMELLIBRANCHIA.

PLATE XIX.

DREISSENSIA (*continued*).

FIGS.

1—11. *D. lanceolata* (Sow.). (P. 110.)

1—3. Crackers, Atherfield.

1. Leckenby Collection, Woodwardian Museum. *a*, left valve; *b*, ventral—showing opening for byssus.
2. Wiltshire Collection, Woodwardian Museum. *a*, right valve; *b*, ventral.
3. Leckenby Collection. Right valve.

4. *Perna*-bed, Atherfield. Wiltshire Collection, Woodwardian Museum. *a*, left valve; *b*, interior of same.
5. Upper Greensand, Shaftesbury. British Museum, No. 88,894. Left valve.

6—11. Greensand, Blackdown.

6. Wiltshire Collection, Woodwardian Museum. *a*, left valve; *b*, part near the umbo × 2; *c*, dorsal of both valves.
7. Wiltshire Collection. *a*, right valve; *b*, ventral; *c*, interior of same.
8. Bristol Museum. The type of ***Mytilus prælongus***, Sowerby.
9, 10. Wiltshire Collection. Left valves.
11. Bristol Museum. One of the types of ***Mytilus tridens***, Sowerby. *a*, right valve; *b*, antero-ventral.

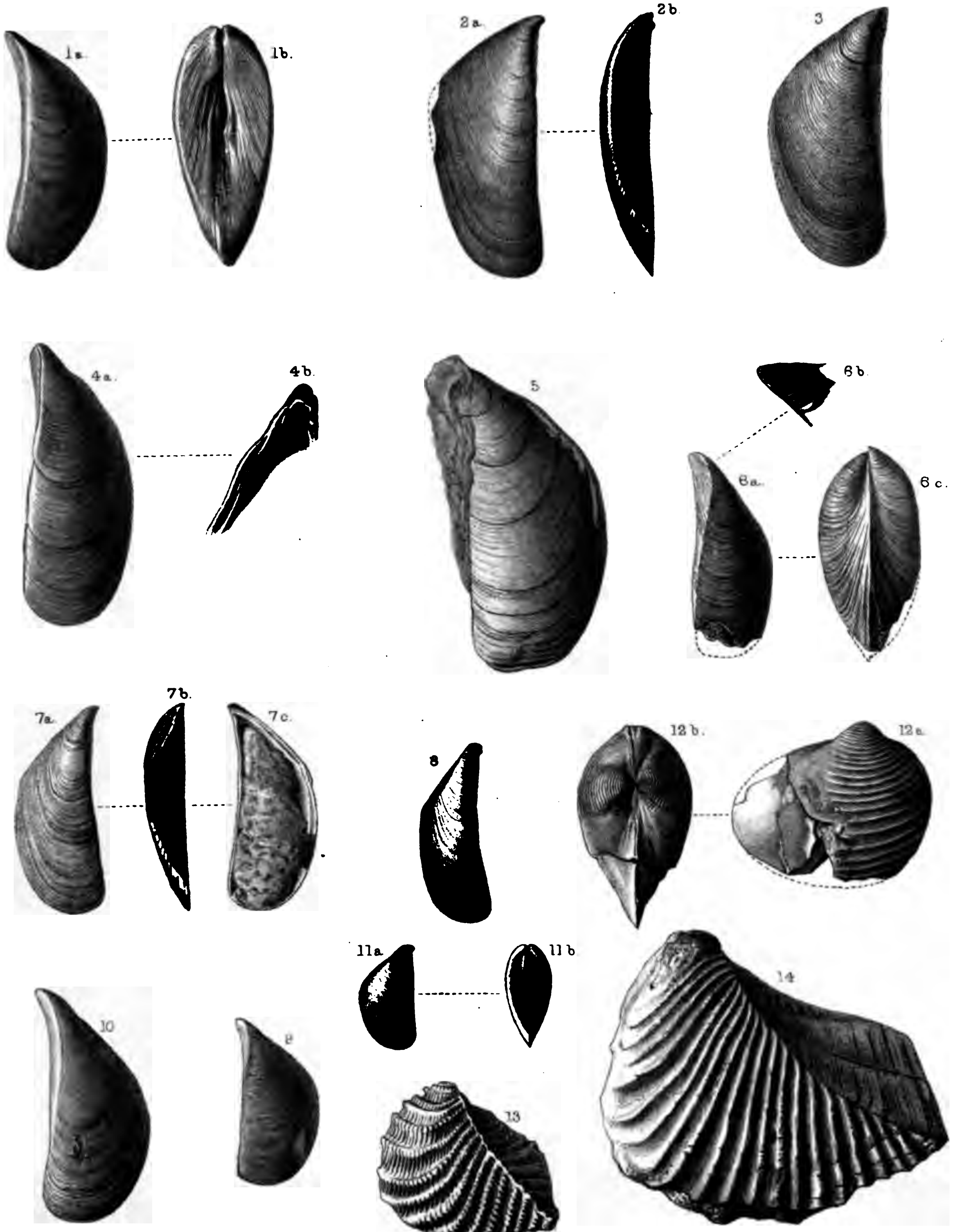
Genus—TRIGONIA, *Bruguière*.

12. *T. dunscombensis*, Lyc. Cenomanian (Bed 11), Humble Point, Lyme Regis. Museum of Practical Geology (No. 6774). *a*, right valve; *b*, dorsal. (P. 78.)

13. *T. ornata*, d'Orb. Hythe Beds, Lympne. Museum of Practical Geology (No. 6771). Left valve. (P. 85.)

14. *T. crenulata*, Lam. Cenomanian (Bed 10), Dunscombe. Mr. Meÿer's Collection. Left valve. (P. 82.)

PLATE XIX.



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CRETACEOUS LAMELLIBRANCHIA.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1900.

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MDCCCC.

A MONOGRAPH

OF THE

BRITISH CARBONIFEROUS LAMELLIBRANCHIATA.

BY

WHEELTON HIND, M.D., B.S.LOND., F.R.C.S., F.G.S.,
MEMB. SOC. GEOL. BELGIUM.

PART V.

CŒLONOTIDÆ, SOLENOMYIDÆ, CONOCARDIIDÆ, CARDIIDÆ.

PAGES 361—476; PLATES XL—LIV.

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Family Cœlonotidæ, *M'Coy*, 1855.

Genus Sanguinolites, *M'Coy*, 1844.

Sanguinolaria (?), *Phillips*, 1836. Geol. Yorks., pt. ii, p. 208.

Cucullæa (pars), *Phillips*, 1836. Ibid., p. 210.

Cypricardia (pars), *de Koninck*, 1843. Anim. foss. Terr. Carbonif. Belg., p. 93.

— (Isocardia on Pl. II, figs. 8 *a*, *b*), *de Koninck*, 1843. Ibid., p. 93.

Sanguinolaria, *Portlock*, 1843. Geol. Rep. Londonderry, p. 443.

Cypricardia, *Portlock*, 1843. Ibid., p. 441.

Sanguinolaria, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 100.

Cypricardia (pars), *Morris*, 1843. Ibid., p. 85.

Cucullæa (pars), *Morris*, 1843. Ibid., p. 84.

Sanguinolites (pars), *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 47.

Orthonota, *Salter* in *Phillips*, 1848. Mem. Geol. Surv. Gt. Brit., vol. ii, pt. 1, p. 360.

Cypricardia (pars), *Brown*, 1849. Illust. Foss. Conch., p. 199.

Sanguinolaria (pars), *Brown*, 1849. Ibid., p. 219.

Lyonsia (pars), *d'Orbigny*, 1850. Prodrome Paléontol., vol. i, p. 128.

Cypricardia (pars), *d'Orbigny*, 1850. Ibid., p. 130.

Leptodomus, *M'Coy*, 1851. Ann. Mag. Nat. Hist., ser. 2, vol. vii, p. 175.

Solenopsis (pars), *de Ryckholt*, 1852. Mélanges paléontol., pt. 2, p. 55.

Sanguinolites (pars), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.

— — *M'Coy*, 1855. Brit. Pal. Foss., p. 276.

Leptodomus, *M'Coy*, 1855. Ibid., p. 508.

Solen (pars), *Eichwald*, 1860. Lethæa Rossica, p. 1038.

Sanguinolites (pars), *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 53.

Leptodomus (pars), *Young and Armstrong*, 1871. Ibid., p. 52.

Allorisma, *Meek and Worthen*, 1873. Geol. Surv. Illinois, vol. v, p. 585.

Sanguinolites (pars), *Young, Armstrong, and Robertson*, 1876. Cat. West Scottish Foss., p. 55.

Leptodomus (pars), *Y., A., and R.*, 1876. Ibid., p. 54.

— *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 102.

Sanguinolites (?), *R. Etheridge, jun.*, 1877. Geol. Mag., dec. 2, vol. iv, p. 246.

— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 311.

Pandora, *R. Etheridge, jun.*, 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 17.

Sanguinolites (pars), *Kirkby*, 1880. Ibid., vol. xxxvi, p. 586.

Non — *Barrois*, 1882. Terr. Anciens Asturias, &c., p. 345.

— *R. Etheridge, jun.*, 1882. Proc. Roy. Phys. Soc. Edin., vol. vii, p. 57.

— *Walcott*, 1884. Pal. Eureka District (U.S. Geol. Surv.), p. 247.

Sanguinolites (pars), *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 58.
Sphenotus, *Hall*, 1885. Nat. Hist. N. York Palæontol., vol. v, pt. 1; Lamellibr., vol. ii, p. xxxiii.
Sanguinolites (pars), *Young*, 1888. Trans. Geol. Soc. Glasgow, vol. viii, p. 293.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.
Leptodomus (pars), *Etheridge*, 1888. Ibid., p. 284.
Sanguinolites (pars), *Miller*, 1889. N. Amer. Geol. Palæontol., p. 509.
Sphenotus, *Miller*, 1889. Ibid., p. 513.
Non Sanguinolites, *Etheridge* in *Ward*, 1890. Trans. N. Staff. Min. Mech. Eng., p. 127.
— — *Meek and Worthen*, 1890. Pal. Illinois, vol. viii, p. 129.
— *Tornquist*, 1896. Fossilführ. Untercarbon. Sudvogesen, Abh. geol. Karte Elsass-Lothr., pt. 2, vol. v, p. 119.

Generic Characters.—Shell transverse, oval; the ends rounded, the posterior deeper in the dorso-ventral diameter than the anterior; very inequilateral, compressed, strongly carinate, with a much-compressed and hollowed dorsal slope, often crossed by one or more radiating lines or ridges. Lunule and escutcheon large, the latter bounded externally by an erect, curved ridge.

Interior.—The anterior adductor muscle-scar is large, deep, and bounded behind by a curved ridge; the posterior shallow, remote from the hinder margin, and placed close beneath the hinge. Pallial line entire. The hinge is probably edentulous in all species, certainly in some, with a rolled and thickened and elongated margin posteriorly.

Exterior.—The surface is ornamented with parallel concentric ribs or lines, which, as a rule, pass into striæ on the posterior slope. Surface tuberculated.

Observations.—The genus *Sanguinolites* was erected by M'Coy in 1844, and included shells previously described by Phillips under *Sanguinolaria*, together with others newly described by M'Coy. It has been correctly pointed out by de Koninck and others that several of the shells referred by M'Coy to *Sanguinolites* were so different in character that they could not be correctly included in one genus. Hence very great confusion has arisen as to the limitation of the genus, which has been made worse by the invention of new genera, which in a large measure have included shells which can be referred to *Sanguinolites*, if the type of that genus be taken as *S. angustatus*, the first species described under the genus. I consider the correct solution of the difficulty is to take this species as the type of the genus, and to include in it only those shells which have undoubted affinity to it.

Fortunately, too, *S. angustatus* is a very typical shell of the genus. M'Coy, while recognising the species, re-described it under the synonym *S. discors*.

M'Coy originally described fifteen species as belonging to *Sanguinolites.* Of these, only four should in my opinion be removed from the genus,—*S. arcuatus*, Phill., sp. (*Edmondia*), *S. costellatus* (1844), and *S. radiatus* (*Solenomya*), and *S. sulcatus*, Phill., sp. (*Edmondia*).

In a later work, however (*op. supra cit.*), 1855, M'Coy unfortunately enlarged the genus, and included *Allorisma*, King, referring to the genus at the same time certain shells from the Upper Ludlow series and Carboniferous beds, which should not be included in the genus. He described eight species from Carboniferous and Permian rocks, three of which, *S. clava*, *S. sulcatus*, and *S. lunulatus*, can be no longer included, as they possess a sinuated pallial sinus, and no angular ridges externally, although in hinge characters they have a certain resemblance to typical species of the genus. The genus *Sanguinolites*, however, hardly deserves the criticisms with which de Koninck, Hall, and others have assailed it.

Salter thought that *Orthonota* should include the Carboniferous forms described as *Sanguinolites* and *Allorisma*, and there is no doubt that there is a close relationship between that genus and certain compressed elongated species, *e. g. S. plicatus;* but Hall shows that *Orthonota* also has been much misunderstood (*op. cit.*, p. xlv), and says, " The species of this genus are always elongate, extremely inequilateral, without external ligamental cicatrix or lunule, which are always marked features in the *Grammysiidæ*." The absence of lunule and escutcheon at once separates *Orthonota*, Conrad, from *Sanguinolites*, M'Coy.

I have pointed out at p. 228 the unsatisfactory character of *Leptodomus*, M'Coy, and that the shells included in the emended description were totally different from those included in the first. *Leptodomus costellatus* should undoubtedly be included in *Sanguinolites*, and it is astonishing that M'Coy should refer shells so similar in character as those he describes as *S. variabilis*, ovate variety, and *Leptodomus costellatus*, to different genera.

The genus *Sphenotus*, Hall, appears to me to be probably unnecessary, as the general characters of the genus are identical with *Sanguinolites;* but Hall describes the hinge as possessing " two short, narrow cardinal teeth beneath the beak of the right valve, and with one or two extremely slender lateral teeth." Only one figure of the hinge is given, and that is shown to be edentulous.

Cimitaria is another genus which I think should be included in *Sanguinolites.* It possesses, as stated in the original diagnosis, no character which can be pointed out as of diagnostic value in separating these two genera; and shells referred to *Cimitaria* possess the curved hinge-line, with its concavity upwards, which is seen in *S. angustatus*, the type of the genus, and in others. In addition, *Cimitaria* has the tuberculated periostracum seen in many of the species of *Sanguinolites.*

Some of the species of *Sanguinolites* found in Scotland have been referred to *Cypricardia*, following de Koninck's earlier work.

De Koninck adopted M'Coy's genus *Sanguinolites* in his larger work, and referred to it no less than fifty-three species. Of these twenty-eight were new, but certain shells, notably *Parallelodon squamosus*, Phill., sp., which does not belong to the genus, were included; and also a group of very strongly carinate wedge-shaped shells, which I have separated under the genus *Mytilomorpha*, with *M. rhombea* as the type. Probably many of the species will be found to be the young or varietal forms of others, as several are founded on a very slender amount of evidence.

De Koninck has, however, separated a group of shells under the genus *Chænomya*, Meek, which I replace in *Sanguinolites*. In the first place, it is not easy to understand why de Koninck referred his shells to this genus, for *Chænomya* is stated by Meek to have a "pallial line with a broad, shallow sinus;" and de Koninck correctly states that his shells have an entire pallial line, and on that account I think that they cannot be placed in *Chænomya*. Further, de Koninck is in error in stating that his shells gape. This idea was apparently due to the incomplete filling of the interior of the shell with matrix, or its fracture, for when specimens are obtained whole the shells are seen to be close all round. Five species are referred to *Chænomya* by de Koninck, three of which, *C. jucunda*, *C. Walciodorensis*, and *C. Omaliana*, occur in Great Britain; and the two latter form a group of the genus *Sanguinolites* which comes midway between the group of which *S. angustatus* and *S. costellatus* are the types. *C. jucunda* should be referred to the genus *Tellinomorpha*, de Koninck; *Chænomya Vaulxiana* is, I should judge from the figure, probably an *Edmondia*. De Koninck considers that *S. discors* is the type of the genus *Sanguinolites;* but if on the ground of priority, it is difficult to understand, as this species was sixth in the list of those described by M'Coy. As a matter of fact, this species is undoubtedly a synonym of *S. angustatus*, which is the first species described under the genus, and therefore the published type. De Koninck subdivided *Sanguinolites* into three groups, distinguished by the number or strength of the radiating lines or folds on the dorsal slope. This subdivision I hesitate to adopt, as I find in some species the number or strength of these lines varies in individuals. Tornquist, in discussing the affinities of the genus, largely follows de Koninck, but seems doubtful of the real position of the genus and of some of its characters. He states, p. 122, that there is some difficulty in discriminating between certain species of *Edmondia* and *Sanguinolites;* but this observation must be based on a misunderstanding of the characters of the genera. The total absence of lunule and escutcheon in the former is quite sufficient to at once distinguish the one genus from the other.

A much more difficult matter to decide is the proper family to which to refer *Sanguinolites*. M'Coy erected a new family, *Cœlonotidæ*, which he considered intermediate between *Mytilus* and *Astarte*, and included in it *Sanguinolites*, *Grammysia*, *Leptodomus*, and *Myoconcha*. De Koninck and Meek and Hayden, on the other hand, in spite of the absence of an internal cartilage-support, and a non-sinuated pallial sinus, place *Sanguinolites* in the family *Anatinidæ*. Stoliczka, again, places it in the *Solemyidæ;* and Tornquist in the *Solenopsidæ*.

There can be no doubt that the genus is closely related to *Grammysia*, and M'Coy recognised this fact when he placed both genera in his family *Cœlonotidæ*, the systematic position of which is, I consider, far more correctly indicated by him than by subsequent authors. Fischer ('Man. de Conchyliologie,' p. 1173) appears to have erected a family *Grammysiidæ*, in which he placed *Grammysia*, de Verneuil, *Sphenomya*, Hall, and *Protomya*, Hall; and curiously enough, he placed this family immediately after *Anatinidæ*. A large group of genera, amongst which are *Sanguinolites* and many dissimilar genera—*e.g.* *Cardiomorpha* and *Sedgwickia*, which evidently cannot belong to the same group, having no affinity whatever to *Anatina*—are provisionally referred to *Grammysiidæ*. *Cœlonotidæ*, M'Coy, evidently has the priority over *Grammysiidæ*. The relationship of *Sanguinolites* to byssiferous groups of shells is well shown in the well-marked sinus which all the species possess; and although there is no evidence whatever that *Sanguinolites* possessed a byssus, it has indications of a descent from some byssiferous ancestor. The oblique ridge, hollow dorsal slope, and lines of radiating tubercles recall forcibly the palæozoic Arciform shells, while the well-marked lunule and escutcheon and concentric ribbings approach the characters of *Astarte* and *Crassitella*. The hinge is peculiar, and taking this into consideration with the fact that, as a group, *Sanguinolites* and *Grammysia* do not fall readily into any family, I think there can be no doubt that M'Coy was warranted in forming a new family to receive them. Tornquist has, curiously enough, placed *Edmondia* in *Grammysiidæ*, with which it has hardly one important character in common, and has referred *Sanguinolites* to another family altogether.

Tellinomorpha, de Koninck, and *Allorisma*, King, are closely related to *Sanguinolites*, and should, I think, be placed in the same family, in spite of the fact that *Allorisma* has a deeply sinuated pallial sinus. A parallel case is met with in the family *Nuculidæ*, where the majority of the genera have a simple pallial line; but *Yoldia* has a sinuated line.

Allorisma is separated from *Sanguinolites* by the absence of an oblique ridge, by the presence of a pallial sinus, and by the peculiar character of the anterior margin, which seems to be continuous with the anterior edge of the umbo. *Tellinomorpha* has a cardinal tooth in the hinge and no oblique ridge.

It is interesting to note that the species of *Sanguinolites* fall into two groups, according to the character of the ornament of the surface of the shell, in precisely the same manner as obtains in the genus *Edmondia*. There is a well-marked group characterised by concentric ridges and sulcations, of which the type is *S. angustatus*, and a smoother group of which the type is *S. tricostatus*. The latter group has all the external characters of *Pleurophorus*, but I cannot satisfy myself that they possess the characteristic hinge of this genus. The genus *Cypricardella* similarly contains two groups, according as their surface is ribbed or smooth.

Sanguinolites angustatus, *Phillips*, sp. Plate XL, figs. 1—6.

Sanguinolaria ? angustata, ***Phillips***, 1836. Geol. Yorks., pt. 2, p. 208, pl. v, fig. 2.
— — ***Morris***, 1843. Cat. Brit. Foss., 1st edit., p. 100.
Sanguinolites angustatus, ***M'Coy***, 1844. Synops. Carb. Foss. Ireland, p. 48.
— discors, ***M'Coy***, 1844. Ibid., p. 49, pl. viii, fig. 4.
Sanguinolaria angustata, ***Brown***, 1849. Illust. Foss. Conch., p. 219, pl. xc, fig. 12.
Lyonsia angustata, ***d'Orbigny***, 1850. Prodrome Paléont., vol. i, p. 128.
Sanguinolites angustatus, ***Morris***, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
— discors, ***Morris***, 1854. Ibid., p. 223.
— — ***Griffith***, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 35.
? — — ***Young and Armstrong***, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 53.
Compare Allorisma costata, ***Meek and Worthen***, 1873. Geol. Surv. Illinois, vol. v, p. 585.
? Sanguinolites discors, ***Young, Armstrong, and Robertson***, 1876. Cat. W. Scott. Foss., p. 55.
— angustatus, ***Bigsby***, 1878. Thesaurus Devonico-Carboniferus, p. 311.
— discors, ***de Koninck***, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 60, pl. xv, fig. 33.
— angustatus, ***Etheridge***, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.
— discors, ***Etheridge***, 1888. Ibid., p. 289.

Specific Characters.—Shell of moderate size, transversely oblong, very inequilateral, tumid. The anterior end is short and gently convex, narrowed, its margin almost elliptical. The inferior border is gently and regularly convex, the arc of a very large circle. The posterior border is blunt and truncate, very slightly convex, but more so above, where it meets the superior border at an obtuse angle. The postero-inferior angle is a rounded right angle. The hinge-line is long and almost straight, but appears to be curved, so that its arc is parallel with the inferior border. The umbones are elongated, small, gibbose, incurved and contiguous, very slightly elevated above the hinge-line, and placed in the anterior fifth of the valve. Passing downwards from the umbo to the postero-inferior angle is a rounded ridge, which separates the anterior convex part of the valve from the rapidly compressed dorsal slope. In very large examples this part of the shell is subdivided into two more or less equal parts by a less apparent linear ridge, which terminates about the centre of the posterior border. Lunule and escutcheon well developed. The latter is elongate and narrow.

Interior.—The adductor scars are almost obsolete. The anterior portion of the hinge-plate has not been seen; posteriorly it has a rolled and thickened edge. Pallial line entire. The oblique ridge is not nearly so well marked in casts as it is in testiferous examples.

Exterior.—The surface is ornamented with equidistant, regular, concentric, elevated, rounded ridges, which are crowded together in front, but become somewhat separated by deep narrow grooves as they pass backwards, where they all appear to terminate abruptly at the oblique line which passes from the umbones to the postero-inferior angle. These ridges, however, much flattened and compressed, bend suddenly upwards and pass to the superior border, becoming bent again in a forward direction at the oblique line which bisects the dorsal slope. The ridges and grooves are themselves smooth. Shell thin.

Dimensions.—Fig. 3, Pl. XL, from Poolvash, Isle of Man, measures—

Antero-posteriorly	55 mm.
Dorso-ventrally	22 mm.
From side to side	16 mm.

Localities.—England: the Carboniferous Limestone of Bolland, Yorkshire; Narrowdale, Staffordshire; Castleton and Thorpe Cloud, Derbyshire. Poolvash, Isle of Man. Scotland: Lower Limestone series of Kerrsland Glen, Beith, Ayrshire; Easter Bucklyvie, Donibristle, Fife. Ireland: the Carboniferous Limestone of Bruckless and Anakish Quarry, Cork.

Observations.—This species was described by Phillips under the generic name *Sanguinolaria*, and the species was adopted by M'Coy and made the type of *Sanguinolites*. Fortunately the type specimen has been preserved and is now in the Gilbertson Collection of the British Museum (Natural History), and I am able to refigure the specimen, Pl. XL, fig. 1, by the kind permission of the authorities. It is a fairly full-grown shell, and is stated to have come from Bolland.

A comparison of the type of M'Coy's *S. discors*, fig. 2, Pl. XL, which is preserved in the Griffith Collection of the Science and Art Museum, Dublin, demonstrates that it is the young of *S. angustatus*, and therefore must be regarded as synonymous with Phillips's species. De Koninck, neglecting *S. angustatus*, considered *S. discors* as the type of the genus, and noted its occurrence in the Carboniferous Limestone of Visé.

This species is quoted by Young and Armstrong as occurring in the Upper Limestone series of Bowertrapping and the Lower Limestone series of Craigenglen in the west of Scotland; but I am not able to confirm their diagnosis, having met with no specimen of this species from those localities.

I have, however, seen two specimens of the species in the collection of Mr. R. Craig, of Beith, from the Kerrsland Glen beds (upper part of the Lower Limestone series of the west of Scotland). One of these is figured, Pl. XL, fig. 6.

Fig. 5, Pl. XL, is the only specimen I have met with showing the external characters of the species so well preserved. Lamellibranchs preserved in limestone rarely have the exterior of the valve in its original condition.

I do not think that any other species of the genus can be confused with *S. angustatus*. The only two which have any even superficial resemblance to it are *S. clavatus*, which is more convex and has a narrowed posterior end, and *S. argutus*, which is more convex, less transverse, and has a very distinct oblique ridge and a deeper concave dorsal slope.

I would draw attention to the great resemblance between *Allorisma costata*, Meek and Worthen (*op. cit.*), and *S. angustatus*. Judging simply from the figure and description of the American shell, I can see no specific difference between them.

SANGUINOLITES ARGUTUS, *Phillips*, sp., 1836. Plate XL, figs. 15, 16.

CUCULLÆA ARGUTA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 210, pl. v, fig. 20.
ARCA ARGUTA, *de Kon.*, 1843. Foss. Carb. Belg., p. 116, pl. iii, figs. 1 & 12.
CUCULLÆA ARGUTA, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 84.
— — *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 72.
ARCA ARGUTA, *de Verneuil*, 1845. Géol. Russie, etc., vol. ii, p. 313, pl. xix, fig. 12.
CUCULLÆA ARGUTA, *Bronn*, 1848. Nomenclat. palæontol., p. 356.
ARCA ARGUTA, *d'Orbigny*, 1850. Prodrome Paléontol., vol. i, p. 134.
CUCULLÆA ARGUTA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 197.
— — *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 92.
ARCA ARGUTA, *d'Eichwald*, 1860. Lethæa Rossica, vol. i, p. 988.
Non — — *Armstrong and Young*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 49.
— — — *Armstrong, Young, and Robertson*, 1876. W. Scott. Foss., p. 53.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 298.
MACRODON ARGUTA, *von Möller*, 1880. Congrès Internat. Géol. Paris, p. 117.
? PARALLELODON ARGUTUS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 154, pl. xv, fig. 40.

CUCULLÆA ARGUTA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 282.
PARALLELODON ARGUTUS, *Julien*, 1896. Carbonifère marin de la France centrale, p. 48.
MACRODUS ARGUTUS, *Tornquist*, 1896. Fossilführ. Untercarbon. Sudvogesen, ii, Abh. geol. Karte Elsass-Lothr., vol. v, p. 104, pl. xix, fig. 31.

Specific Characters.—Shell below medium size, very inequilateral, transversely ovate, gibbose, strongly carinate, narrowed in front and behind. The anterior end is small, narrowed, gradually compressed into the margins; and its border is rounded, the lower part being the arc of a much larger circle than the upper. The lower border is slightly but regularly convex, and meets the posterior border at a blunted acute angle. The posterior margin is short, straight, obliquely truncate from above downwards and backwards, joining the hinge-line above at a very obtuse angle. The hinge-line is long, slightly arched in front, but straight and depressed posteriorly. The umbones are small, pointed, incurved, tumid, somewhat raised, and placed in the anterior quarter of the shell. Passing downwards and backwards from the umbo obliquely to the postero-inferior angle is a sharp narrow ridge, which separates the convex part of the valve from the dorsal slope. The latter is so much and so rapidly compressed as to be markedly concave from side to side. The concave slope is narrow close to the umbo, but becomes broader as it descends, and is limited internally by an acute line which separates it from the elongated escutcheon. Passing from the umbo to the posterior border halfway across this slope is an obscure radiating groove. Lunule well developed.

Interior.—Quite unknown.

Exterior.—The surface is ornamented with well-marked concentric ribs, which are crowded and bifurcated at times in front, or have others introduced between them; towards the lower margin of the valve they may interdigitate. These ribs cease abruptly along the oblique ridge, and are represented on the dorsal slope by close-set fine lines, passing directly upwards to terminate in the upper border.

Dimensions.—I have met with no perfect example, but the dimensions of the type of Phillips's *Cucullæa arguta* (Pl. XL, fig. 15) are—

Antero-posteriorly . . .	19 mm. (estimated)
Dorso-ventrally	10 mm.
From side to side	8 mm.

Localities.—England: the Carboniferous Limestone of Bolland, Yorkshire, and Thorpe Cloud, Derbyshire.

Observations.—The type specimen of Phillips's *Cucullæa arguta* is preserved in the Gilbertson Collection in the British Museum (Natural History), Cromwell

Road, and I am permitted by the kindness of Dr. Henry Woodward to refigure it, Pl. XL, fig. 15. It unfortunately consists of only the anterior two-thirds of a right valve; the curious and characteristic posterior end is not seen beyond the acute oblique line. I have a specimen, however, of the posterior two-thirds of the left valve, fig. 16, Pl. XL, which therefore allows a complete description of the exterior to be given at last. Curiously enough, in spite of the apparent rarity of the shell, it has been re-described or catalogued by several authors, who have all referred the shell to one or other genus of the family *Arcidæ*, although its very definite, concentric, external sculpture is not like that which obtains in any member of that family; nor are there the radiating lines which are possessed by all striated species of the latter. The acute ridge, and hollowed, smooth dorsal slope and concentric ribs are in complete accordance with characters which I consider as diagnostic of the genus *Sanguinolites.*

To Phillips's original description the following note is added: "The figure is partly restored at the extremities." This should read *posterior extremity* only, as the anterior end of the type specimen is quite perfect.

Whether or no the shells which de Koninck and de Verneuil referred to Phillips's species really belonged to it, I am unable to say. The former professes to have seen the anterior part of the hinge, but it is not figured. In de Koninck's later work the shell is unrecognisable from the drawing; but it is stated that the artist had not made the ribs strong enough. I cannot conceive that any artist could have possibly had a specimen of *S. argutus* in his hands when he drew that figure; neither does de Koninck's description convey to my mind the characters of Phillips's shell. It is as follows: "Une carène bien prononcée traverse diagonalement sa surface qui en outre est garnie de nombreuses stries concentriques assez regulières et quelques fois assez profondes." Writing of the umbones, he states, "Ils sont très rapprochés et séparés par une facette ligamentaire très étroit et presque linéaire." As to the hinge, the same partial description is given as in his earlier work. From the whole description I consider it extremely doubtful whether *S. argutus* really occurs in Belgium, and think that a totally different shell has been described under this name, which, if de Koninck really saw, as he states, the anterior portion of the hinge, evidently belongs to *Parallelodon.* Whether Julien and Tornquist have Phillips's or de Koninck's shell from the Carboniferous beds of Central France and Alsace, I am unable to say.

I have not met with any specimens of this species in the Carboniferous beds of Scotland, and suspect that some other shell must have been erroneously identified as *S. argutus* by the authors of the Scottish catalogues referred to above.

This species resembles *S. angustatus* more nearly than any other, but can at once be differentiated by the following characters:—Less transverse, more regularly ovate outline, less prominent oblique keel, and a smaller but deeper concave dorsal slope. The concentric ribs on the valve are less regular, new ones arising and others disappearing. It has occurred to me that possibly *S. argutus* might be a young shell of *S. Omalianus;* but the latter has not such an acute keel and is less transverse and more gibbose.

As far as my experience goes *S. argutus* is one of the rarest Carboniferous Lamellibranchs.

SANGUINOLITES ANGULATUS, de Koninck. Plate LXII, figs. 1—4.

SANGUINOLITES ANGULATUS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 71, pl. xvi, figs. 4 and 18.

Specific Characters.—Shell small, inequilateral, transversely ovate, strongly carinate, rapidly compressed along the dorsal slope, narrower behind than at the centre. The anterior end is gibbose, and its margin regularly rounded. The inferior border forms the longest diameter of the shell, and is very gently convex, making a well-marked angle behind with the posterior margin. The latter is obliquely truncate from above downwards and backwards, and almost straight, making an obtuse angle above with the hinge-line. The dorsal margin is almost straight, somewhat depressed posteriorly, much shorter than the inferior margin. The umbones are small, tumid, incurved, and twisted forwards; placed very far forwards, and only slightly elevated. Passing downwards and backwards from the umbo to the postero-inferior angle is a well-marked angular keel, separating a rapidly compressed and hollowed dorsal slope from the rest of the valve, which is regularly convex. Lunule small, but deep and cordate. Escutcheon large and elongate, bounded by an angular curved ridge.

Interior.—As yet unknown. Pallial line entire and remote from the margin.

Exterior.—The surface is marked by regular, fine, concentric lines of growth, more apparent near the lower margin. The region of the umbones and the dorsal slope is almost smooth. Shell thin.

Dimensions.—Pl. XLII, fig. 3, from the Carboniferous Limestone of Thorpe Cloud, measures—

Antero-posteriorly	17 mm.
Dorso-ventrally	8 mm.
Thickness of valve	3 mm.

Locality.—The Carboniferous Limestone of Thorpe Cloud, Derbyshire.

Observations.—De Koninck has figured two specimens of this species: one, a very large one, from the Carboniferous Limestone of Pauquys; the other from

Furfooz, étage II. The latter specimen is only a little larger than that of the series I have obtained from Thorpe Cloud. Notwithstanding the difference in mere size of the English specimens, I have no hesitation in referring them to de Koninck's species. With regard to the small size which this species exhibits at Thorpe Cloud, it is interesting to note that two other species of the genus, *S. Omalianus* and *S. angustatus*, which occur with it in the same bed, are also much dwarfed, being only half the size of specimens of the same species obtained from the Isle of Man or Ireland; a few other species from that locality also exhibit this condition of dwarfing.

Sanguinolites angulatus seems to form a link between this genus and *Mytilomorpha;* but judging from the character of the ornament, so unlike that which obtains in *Mytilomorpha*, and the presence of a radiating line bisecting the dorsal slope, never present in the latter genus, it is correctly placed with *Sanguinolites*. It is unfortunate, however, that the adductor muscle-scars and the hinge have not been observed; for it is often impossible to separate accurately shells of different genera which possess similar forms on external characters only. This species resembles *S. argutus* in having a very sharp keel and a much-hollowed dorsal slope; but it is easily distinguished by its more transverse shape and the absence of well-marked concentric ribs on the surface.

SANGUINOLITES OMALIANUS, *de Koninck*, sp., 1842. Plate XL, figs. 17—24.

PHOLADOMYA OMALIANA, *de Koninck*, 1842. Anim. Foss. Terr. Carb. Belg., p. 65, pl. v, fig. 4.
— TRANSVERSA, *de Ryckholt*, 1847. Mél. paléontol., 1e partie, p. 159, pl. ix, figs. 18, 19.
— OMALIANA, *Bronn*, 1848. Nomencl. palæontol., p. 964.
LYONSIA OMALIANA, *d'Orbigny*, 1850. Prodrome paléontol., vol. i, p. 128.
? PANOPÆA GRAVIDA, *de Ryckholt*, 1853. Mélanges paléontol., 2me partie, p. 30, pl. xi, figs. 5, 6.
MYACITES? OMALIANA, *Morris*, 1854. Cat. Brit. Foss., p. 213.
— — *Baily*, 1875. Figures of Char. Brit. Foss., vol. i, p. 115, pl. xxxix, fig. 9.
ALLORISMA OMALIANA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 295.
PANOPÆA GRAVIDA, *Bigsby*, 1878. Ibid., p. 311.
CHÆNOMYA OMALIANA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 6, pl. i, figs. 12—15.
Non SANGUINOLITES OMALII, *de Koninck*, 1885. Ibid., p. 74, pl. xv, figs. 11, 12.
— MYACITES OMALIANA, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 286.

Specific Characters.—Shell inequilateral, transversely ovate, gibbose, twisted on itself, obscurely and obliquely carinate. The anterior end is short, and narrowed from above downwards by the descent of its upper border, which is occupied by a very long and sloping lunule. The anterior border is elliptically curved. The inferior border is slightly sinuous about its centre, and becomes markedly convex behind, where it is curved bluntly upwards to pass into the posterior margin, which is straight and obliquely truncate from above downwards and backwards above, but bluntly rounded and somewhat produced below. The hinge-line is shorter than the greatest antero-posterior diameter, much depressed in front, and produced, straight or slightly arched upwards behind. The umbones are tumid, incurved, and pointed, somewhat obliquely set, much raised above the hinge-line, and situated in the anterior fourth of the valve. Passing downwards and backwards to the postero-inferior angle is a well-marked oblique ridge, with a slight curvature having its concavity upwards, angular above but more obtuse below. The ridge becomes somewhat less marked as it approaches the edge of the valve ; it separates the dorsal slope from the rest of the valve. Passing from the umbo towards the postero-superior angle is an erect curved ridge, which separates the dorsal slope from the large, broad, and deep escutcheon. The valves are very convex from above downwards, but irregularly curved from before backwards. The anterior portion of the valve is moderately convex, the greatest convexity being oblique and along a line from the umbo to a point a little in front of the postero-inferior angle. Immediately in front of this convexity is a well-marked sinus, which becomes broader as it approaches the inferior margin, when it often appears as a sinuosity in its curvature; in some specimens this sinus is almost obsolete. The dorsal slope is large, broad, and hollow; and the escutcheon is long, comparatively broad, and excavated.

Interior.—The arrangement of the muscle-scars seems to be identical with that which obtains in *S. variabilis.* The pallial line is entire. The hinge has not yet been observed. The concavity of the interior is marked with concentric grooves and ribs.

Exterior.—The surface-marking is very variable, but consists of concentric grooves and ribs. In some specimens the ribs bifurcate after passing across the sinus, and are close and narrow. In others they are few and thick, but they disappear altogether on the lower portion of the valve; and on the dorsal slope the grooves and ribs terminate at the oblique ridge. Under the microscope many of the ribs and sulci are finely striated concentrically. The posterior slope is also covered with fine striæ, arranged parallel to the posterior margin. Shell very thin.

Dimensions.—Fig. 22, Pl. XL, a specimen from Tomdeely, co. Limerick, in the collection of the Geological Survey of Ireland, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	35 mm.
From side to side	30 mm.

Localities.—England: the Carboniferous Limestone of Thorpe Cloud, Derbyshire. Scotland: the Lower Limestone series of High Blantyre. Ireland: the Carboniferous Limestone of Tomdeely and Lisbane, co. Limerick.

Observations.—This species was founded in 1842 by de Koninck upon a single specimen from Tournay (*op. cit.*), and was re-described by him in his later work as *Chænomya Omaliana.* The figures in neither work are particularly good, but the description is very accurate, and much fuller than it was his custom to give. De Koninck draws attention to the resemblance between his shell and the *S. variabilis* of M'Coy; the differences between the two he quite appreciates. I cannot, however, agree with de Koninck that the *Allorisma Hamiltonensis* of Shumard and the *Grammysia Hannibalis* of Meek are the same species as the Belgian shell. I have been able to compare specimens, and can see no reason for mistaking the two forms, which in my opinion are quite distinct. The American shell is much less gibbose, regularly ovate, compressed, and much smaller. The concentric ribs do not bifurcate, and are fewer and larger; the dorsal slope is much smaller and more compressed; but there is no doubt that both species belong to the same genus. I think that de Koninck was most probably correct in placing the *Pholadomya transversa* and *Panopæa gravida* of de Ryckholt as synonyms of his shell. The curious surface markings of this species, though much exaggerated, are well seen in the drawing of the latter shell, which was (de Koninck states) an internal cast; and the type specimen is still extant and preserved in the Royal Museum of Natural History at Brussels. The figure given by Baily is a good one, and I believe that Pl. XL, fig. 21, is the specimen which served for the drawing. It was said to be from Lisbane, and to be preserved in the Museum of the Geological Survey of Ireland, and this is the case with the specimen here figured.

De Koninck has described as *Sanguinolites Omalii* a shell figured as *Solenopsis Omalii*, de Ryckholt. This is perfectly distinct from the species under discussion; and, if it is still retained in the genus, must have its specific name changed. The shape of the shell, having a very narrow and produced posterior end, is peculiar, and further examination may show that its generic characters differ from those of *Sanguinolites* in other particulars. *S. Omalianus* belongs to that group of the genus which contains *S. costellatus* and *S. variabilis*, from both of which it differs in important details. In gibbosity *S. Omalianus* is less strongly convex than the former, but more convex than the latter; the rugæ and sulci are much stronger and fewer than in both.

Sanguinolites hibernicus, sp. nov. Plate XLI, figs. 1—4.

Specific Characters.—Shell below medium size, transversely ovate, obliquely gibbose, very inequilateral. The anterior end is very short, compressed, narrowed from above downwards, and elliptically curved, encroached upon above by the lunule. The inferior border is feebly convex, and descends for two thirds of its length, becoming arched upwards posteriorly to meet the posterior margin, with which it forms a bluntly rounded postero-inferior angle. The posterior margin is obliquely truncate from above downwards and backwards; almost straight or slightly convex. The postero-superior angle is well marked and obtuse. The hinge-line is arched in front, long and straight behind. The umbones are elongate, gibbose, incurved and twisted forwards, contiguous and hardly elevated above the hinge-line, and are situated in the anterior fourth of the valve. Passing obliquely downwards and backwards from the umbo to the postero-inferior angle is a low blunt ridge, which separates the general convexity of the valve from the dorsal slope. Another ridge, erect but curved, passes directly backwards, separating the large escutcheon from the dorsal slope. The general surface of the valve is convex, but the line of greatest convexity is oblique, and there is an obscure flattening of the valve at the junction of the anterior and middle thirds.

Interior.—The anterior adductor muscle-scar is large, deep, and placed immediately within the antero-superior angle, and is bounded behind by a shallow ridge. The posterior scar is large and shallow, and is placed just below the hinge-line, remote from the posterior margin. The pallial line is entire. The hinge has not been observed. The internal surface of the valves is smooth.

Exterior.—The surface is ornamented with small, low, concentric ridges, which become almost obsolete when they pass over the oblique ridge, and are bent upwards over the dorsal slope to terminate in the hinge-line. The dorsal slope is bisected by an obscure, broad, radiating ridge. Shell thin.

Dimensions.—Pl. XLI, fig. 3, a testiferous example from Ballymark, in the collection of the Geological Survey of Ireland, measures—

Antero-posteriorly	48 mm.
Dorso-ventrally	23 mm.
From side to side	16 mm.

Localities.—England: the Carboniferous Limestone, Cavedale Quarry, Castleton, Derbyshire. Ireland: the Carboniferous Limestone of Ballymark, Bansha, and Nantinan, co. Limerick.

Observations.—I have established this species on a series of six specimens in the Museum of the Geological Survey of Ireland from the above localities. The species appears to form a link between *S. tricostatus* and *S. Omalianus*, being more gibbose and oblique than the former, and narrower from above downwards, and having its concentric markings much less well developed than the latter.

The figure of de Koninck's *S. Portlocki* may possibly be intended to represent a shell of this species, and if so that name must of course have the priority; but as neither description nor figure sufficiently tallies with the Irish examples, I have hesitated to refer them to this species. *S. Portlocki* is stated to have three radiating folds on the dorsal slope. The Irish shells have only one, beside the main oblique fold. A single, very fine example of this shell has been found at Castleton, Derbyshire (Pl. XLI, fig. 1).

SANGUINOLITES WALCIODORENSIS, *de Koninck*, sp., 1885. Plate XLI, figs. 5—7.

CHÆNOMYA WALCIODORENSIS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 8, pl. i, figs. 18, 19.

Specific Characters.—Shell of medium size, very inequilateral, transversely ovate, obliquely gibbose, compressed in front and on the dorsal slope, somewhat expanded posteriorly. Anterior end short, compressed, narrowed from above downwards, projecting forwards with an elliptically curved border. The inferior border is almost straight in front, but descends until it passes with a very large curve into the posterior border. The latter is extensive, somewhat truncate above, but bellying out below and rounded. The hinge-line is almost straight, somewhat shorter than the antero-posterior diameter of the valve, and raised posteriorly, joining the posterior border at a more or less well-marked obtuse angle.

The umbones are tumid behind, compressed in front, incurved and twisted forwards, close, elevated above the hinge-line, and placed in the anterior quarter of the valve. From the umbones towards the postero-inferior angle the valve is obliquely swollen, the gibbosity becoming rounded off into the compressed and expanded dorsal slope. In front of the oblique swelling the valve is compressed and hollowed by a broad and shallow sinus, the extreme anterior portion being regularly (but slightly) convex. The lunule is large and long. The escutcheon is long and narrow, separated from the dorsal slope by an erect ridge.

Interior.—Unknown.

Exterior.—The surface is covered with fine concentric lines and striæ of growth, which are much more marked in the neighbourhood of the umbo, and may become somewhat ribbed concentrically. The dorsal slope is crossed by a single radiating line, which, however, is not always present. Shell thin.

Dimensions.—Fig. XLI, Pl. 7, measures—

Antero-posteriorly	61 mm.
Dorso-ventrally	29 mm.
Gibbosity of valve	15 mm.

Localities.—Ireland: the Carboniferous Limestone of Ballygarrane and Doohybeg, co. Limerick.

Observations.—This species was founded by de Koninck upon a single valve, obtained from the Limestone of Waulsort, Belgium, by M. Ed. Dupont. It is, however, such a peculiarly shaped shell that there is little or no difficulty in recognising the species. The narrow anterior and expanded posterior end, the oblique rounded gibbosity, and the fineness of the external markings are a series of characteristics which may be relied upon as features diagnostic of the species. I have, unfortunately, not been able to obtain any particulars of the interior, as all the Irish examples to which I have had access for study possess the test.

Sanguinolites Walciodorensis was referred to the genus *Chænomya* by de Koninck; but, for reasons referred to above, I cannot distinguish any characters sufficient to separate the shells, which were described by de Koninck as belonging to this genus, from *Sanguinolites* as amended by him. The specimens, figs. 5—7, Pl. XLI, are in the collection of the Geological Survey of Ireland, in the Museum of Science and Art, Dublin. I found them on tablets bearing the name ***Myacites tumidus***, Phillips, sp.

SANGUINOLITES COSTELLATUS, *M'Coy*, sp., 1851. Plate XLI, figs. 8—10.

Non SANGUINOLITES COSTELLATUS, *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 48, pl. viii, fig. 5.
LEPTODOMUS COSTELLATUS, *M'Coy*, 1851. Ann. Mag. Nat. Hist., ser. 2, vol. vii, p. 175.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 206.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 508, pl. 3 F, fig. 5.
— — *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 52.
— — *Young, Armstrong, and Robertson*, 1876. Cat. West. Scottish Foss., p. 54.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 307.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 284.

Specific Characters.—Shell transversely ovate, exceedingly gibbose, very inequilateral, narrowed and compressed posteriorly. The anterior end is very short, swollen, and bluntly rounded. The inferior border is regularly convex, becoming more so behind, where it rises to become bluntly rounded off into the posterior margin. The latter is bluntly but regularly curved, and forms a tolerably well-marked obtuse angle above with the hinge-line. The latter is elongate but not as long as the longest antero-posterior diameter of the valve, and is curved slightly upwards posteriorly. The umbones are very large, tumid, much incurved, contiguous, elevated high above the hinge-line, placed in the anterior quarter of the valve, but not terminal. Below the umbones in front is a deep and large lunule. Passing obliquely downwards and backwards from the umbo towards the postero-inferior angle is a well-marked blunt curved ridge with its concavity upwards. This ridge separates the dorsal slope from the rest of the valve. The dorsal slope is large, triangular, twisted on itself, almost smooth and concave. It is separated from the large, elongate, deeply excavated escutcheon by a prominent curved ridge. The posterior edges of the valve are depressed, in contact at the bottom of the deep escutcheon. The dorsal slope is bisected by a curved shallow groove, which passes from the posterior side of the umbo and terminates on the posterior border. Anterior to the oblique ridge the valve is very convex; the line of greatest convexity is oblique. From above downwards the valve is very much curved on itself, from before backwards the valve is regularly but less rapidly convex; the convexity is interrupted by an oblique almost obsolete sulcus, which separates the short anterior portion from the rest of the valve.

Interior.—Quite unknown.

Exterior.—The surface of the valve is ornamented with numerous small, regular, close, subangular ribs, parallel with the margin, much fewer in the anterior part of the valve; but just behind the oblique sulcus others become intercalated between them, and they become doubled in number. The ribs become entirely obsolete as they reach the oblique ridge, and pass into fine parallel striæ; these are bent upward with a blunt curve, and pass across the hollow of the dorsal slope to terminate in the upper edge of the valve. The lunule is striated, the ribs of the front part of the shell being continued across it to the edge of the valve in fine lines. The escutcheon seems to be smooth. Shell very thin.

Dimensions.—Pl. XLI, fig. 8, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	30 mm.
From side to side	31 mm.

Localities.—England: the Carboniferous Limestone of Lowick, Northumberland. Scotland: the Lower Limestone series of Craigie, near Kilmarnock; cutting at the horizon of the Hurlet Limestone; on the Kilbirnie Railway;

Gurdy, near Beith; Garngad Road, Glasgow; Roscobie; Woodend, Fordel, and Charleston, Queensferry, Fife.

Observations.—This species was described by M'Coy under the genus *Leptodomus* (*op. cit.*). This was a genus established by him in 1844 to receive a shell now referred to *Protoschizodus fragilis* (see above, p. 250). Later, in 1855, this genus was amended by M'Coy in such a way that it could include neither of its original species (*op. cit.*, p. 277). I am of opinion that the genus as amended is not a good one, and that the shells referred to it do not form a natural group, and can be placed in other well-defined genera.

Sanguinolites costellatus differs in no generic details from the *S. variabilis* "ovate variety," described and figured by M'Coy at the same time. The latter is less strongly curved from above downwards, less convex, and has a narrower, less convex dorsal slope, larger concentric ribs on the shell, and much smaller umbones. Both these species agree in every generic detail with the shell that M'Coy takes as the type of his genus *Sanguinolites* (*S. angustatus*).

S. costellatus seems to have a much more local distribution than *S. variabilis*. As far as I can ascertain at present, it is only found in the Lower Carboniferous Limestone series of Scotland, but is found at this horizon both in the east and west of Scotland. When the railway was made from Giffen to Kilbirnie, in the cutting at Gurdy, near Beith, numerous well-preserved specimens were found in a bed of shale, generally correlated with the limestones of Kerrsland Glen, which form the upper part of the Lower Limestone series of Scotland.

In 1844 M'Coy described a fragment of a shell as *Sanguinolites costellatus*, but this shell turns out to be the posterior end of an internal cast of *Solenomya costellatus*.

SANGUINOLITES VARIABILIS, *M'Coy*, 1851. Plate XLIV, figs. 1, 3—8.

SANGUINOLITES VARIABILIS (pars), *M'Coy*, 1851. Ann. Mag. Nat. Hist., 2nd ser., vol. vii, p. 174.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 508, pl. 3 F, figs. 6, 7.
? — — *Young and Armstrong* (pars), 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 54.
? — — *Armstrong, Young, and Robertson* (pars), 1876. Cat. West. Scottish Foss., p. 55.
— — *Bigsby* (pars), 1877. Thes. Devonico-Carbonif., p. 313.
— — *Etheridge* (pars), 1888. Brit. Foss., pt. 1, Pal., p. 290.

Specific Characters.—Shell subquadrate, gibbose, regularly convex, only slightly compressed posteriorly, inequilateral. The anterior end is short, deep, and tumid; its border rounded. The inferior border is regularly but slightly convex. The posterior border is obliquely subtruncate from above downwards and backwards in the upper part, but below it is bluntly rounded into the inferior border; in older specimens the postero-inferior angle becomes more marked and less curved. The hinge-line is arched in front, but straight or slightly concave posteriorly. The umbones are large, tumid, incurved, pointed, contiguous, elevated above the rest of the valve, and situated in the anterior fourth of the shell. The lunule is large, long, and deep. The escutcheon is much excavated, elongate, and of large size. The valves are convexly curved; but there is a slight sinus or compression (narrow above, but becoming broader as it nears the inferior margin), which commences below the umbones and may be represented by a slight sinuosity at about the centre of the inferior border. There is no oblique ridge, but the valve curves into the dorsal slope along an oblique line, which passes from the umbo to the postero-inferior angle. The dorsal slope is much compressed and hollowed, and is bounded above by an erect angular ridge, slightly curved, becoming concave on its inner aspect, which separates it from the escutcheon. An obscure groove passes across the dorsal slope from the umbo to the posterior margin.

Interior.—The anterior adductor muscle-scar is small and marginal; the posterior large and shallow, and placed immediately below the hinge-line, remote from the posterior end. The pallial line is entire. The hinge is edentulous and narrow. The interior of the valve is marked by fairly deep concentric grooves and ridges, which are wanting in the hollow of the dorsal slope.

Exterior.—The surface is ornamented with concentric rounded folds and sulci, which have the following arrangement:—Commencing at the anterior edge of the valve, the ridges are few and separated by comparatively wide sulci, as a rule regular, but one or two fresh ones may arise independently, or a process may join two ridges. As the ridges pass over the small compression, each one bifurcates, or has a new ridge intercalated between it and its successor, each being about half the size of the undivided ridge. These narrow ridges then pass regularly across the convexity of the shell; but as they approach the dorsal slope they reunite and pass upwards across the dorsal slope, becoming gradually obsolete. In the lower part of the valve the ridges break up into bundles of fine striæ, which curve upwards, so that the posterior part of the dorsal slope is finely striate and at times subimbricate. Shell thin.

Dimensions.—Pl. XLIV, Fig. 3, a specimen from the Redesdale Ironstone, measures—

Antero-posteriorly	41 mm.
Dorso-ventrally	29 mm.
From side to side	23 mm.

Localities.—England: the Redesdale Ironstone Shale, Redesdale, and a bed of Limestone at Lowick, Northumberland.

Observations.—There can be no doubt that M'Coy founded his species *Sanguinolites variabilis* upon two quite distinct shells, one of which does not even belong to the genus, but should be referred to *Allorisma*, for the reason that certain specimens of the same species have a well-marked pallial sinus. I am able to re-figure both the type specimens, and I have had them drawn on the same plate for the sake of comparison (Pl. XLIV, figs. 1 and 2). It will be at once seen that the two shells differ materially in shape, contour, and the character of the surface-markings. The first, therefore, of M'Coy's figures must take the name *Allorisma variabilis;* while I propose to retain the name *Sanguinolites variabilis* for the second.

M'Coy's figure of the former shell is drawn largely from imagination. The type specimen is imperfect in front, and has the matrix still unremoved in front of the umbones, so that the lunule is invisible; and the shell is evidently incomplete in front along the lower margin. M'Coy called his second figure an ovate variety, but this form is not at all uncommon in the Redesdale Ironstone series. As is usual with M'Coy's figures, the shell, a left valve, appears on the plate as a right valve, no allowance having been made for the reversion of the figure during the process of printing.

M'Coy compares his species with *Edmondia sulcata*, but these two species are not likely to be confused, the absence of lunule and escutcheon in *Edmondia* at once serving to distinguish the two shells; and, in addition, the surface-ornaments are totally different with regard to the arrangement of the sulci and ridges. M'Coy notes that the "periostracum is sharply marked with close interrupted striæ and a few minute scattered points, very rarely falling into close regular radiating lines." I have not been able to make out that *S. variabilis* possesses this character, though it is certainly present in *Allorisma variabilis.*

M'Coy gives three localities for his double species: the Lower Limestone of the Isle of Man, Lowick, Northumberland, and Berwick-on-Tweed. I am unable to recognise any Manx shell which could be referred to either of the species, and, unfortunately, there is no evidence to show to which of the two specimens the Berwick shell belonged.

Sanguinolites variabilis much more nearly approaches *S. costellatus* in character, but the valve is not so curved from above downwards, and the dorsal slope is much less hollow and expanded from side to side, being more vertical in position and compressed. The surface-markings are much finer and the ribs more numerous in the latter species.

M'Coy states that the ovate form of this shell has no byssal sinus; but there is a well-marked compression in several of my specimens, which passes from the umbones to the inferior border, but no evidence of any notch. I have remarked before of several genera of Carboniferous Lamellibranchs that the byssal sulcus was present, probably as an ancestral relic. Such a character is markedly present in all species of the genus *Sanguinolites*. M'Coy's figures of his ovate varieties show the contour of the valves very perfectly, but the peculiar arrangement of the markings of the surface are not well brought out or commented upon.

I have been fortunate enough to see the hinge-plate in a small example, Pl. XLIV, fig. 6, where it is seen to be narrow and edentulous; but there is no trace of any external or internal ligament to be made out.

SANGUINOLITES V-SCRIPTUS, sp. nov. Plate XLII, figs. 5—7.

Specific Characters.—Shell below the medium size, somewhat inequilateral, subquadrate, compressed, carinate. The anterior end is comparatively large, comprising about a quarter of the valve, compressed, its dorso-ventral diameter very little less than that of the posterior extremity, with a bluntly rounded margin, most prominent towards the antero-inferior angle. The inferior margin is gently and regularly convex, the postero-inferior angle being well marked and a rounded right angle. The posterior margin is straight, obliquely truncate from above downwards and backwards, making a slightly obtuse angle with the hinge-line. The latter is only slightly arched, and is shorter than the inferior margin. The umbones are tumid, incurved, contiguous, pointed, much elevated above the hinge-line, and placed a little in front of the central dorso-ventral diameter of the valve. An oblique swelling passes downwards from the umbo to the postero-inferior angle, separating the small but compressed dorsal slope from the rest of the valve, the convexity of which is interrupted by a narrow but well-marked sinus, passing from the apex of the umbo to the inferior margin. Lunule small; escutcheon elongate and comparatively large.

Interior.—Unknown.

Exterior.—The surface is ornamented with flattened ribs and sulci, close and narrow in the umbonal region, but becoming larger and further apart as they approach the margin. The ridges have the following curious arrangement:—Arising as very thin lines near the anterior margin, they descend parallel to the margin, and, soon becoming stronger and rib-like, are interrupted as they cross the shell by the narrow sinus which passes from the umbo to the inferior margin. The ribs then pass backwards with an upward curve, so that they are concave downwards, and the posterior limb of the curve is produced lower than the anterior. At the lowest point the ribs are bent upwards and somewhat backwards at an acute angle; and, passing over the oblique gibbosity of the valve, they soon become obsolete, leaving the dorsal slope smooth or only finely striate. In full-grown shells, towards the lower margin in front the ribs may become broken a little, and their line somewhat irregular.

Dimensions.—Pl. XLII, fig. 7, measures—

Antero-posteriorly	27 mm.
Dorso-ventrally	20 mm.
From side to side (estimated)	10 mm.

Locality.—England: in a band of marine shale, about 500 feet below the third bed of Millstone-grit, Congleton Edge, Cheshire; Redesdale Ironstone, Northumberland.

Observations.—I have founded this species on three specimens, two of which I collected from the bed mentioned above at Congleton Edge, and I obtained a single specimen from Redesdale. Although neither specimen is absolutely perfect, the surface-markings are so peculiar that it was impossible to refer the species to any of those hitherto described.

Pl. XLII, fig. 7, possesses the right valve in an almost perfect condition, except that the posterior slope is crushed, and the shell appears more carinate than it really is, judging from the uncrushed portion of Pl. XLII, fig. 6. There can be no doubt of the propriety of referring this shell to the genus *Sanguinolites*, from observation of the escutcheon and the surface-sculpture.

In front *S.* V-*scriptus* is like *S. interruptus*, but the whole shape of the shell is different, being subquadrate, while the latter species is almost elliptical, and, moreover, does not possess the characteristic V-shaped bend in the ribs just anterior to the oblique fold. It occurred to me that this V-bending might be due to crushing; but it is present equally in the young and uncrushed part of the valve, and cannot possibly be due to any but biological causes.

SANGUINOLITES INTERRUPTUS, sp. nov. Plates XLII, figs. 8—10; XLIX, figs. 10, 10 *a*.

Specific Characters.—Shell very inequilateral, transversely elliptical, obliquely gibbose, narrower from above downwards, in front than behind. The anterior end is short, compressed, much narrowed by the approach of its upper and lower margins, its border bluntly rounded. The inferior margin is curved, and descends for its anterior two thirds with a slight sinuation at the junction of the anterior and middle thirds; it then becomes curved upwards to meet the posterior border, the postero-inferior angle being bluntly rounded. The posterior border is straight, obliquely truncate from above downwards and backwards, the postero-superior angle well marked and obtuse. The hinge-line is gently arched in front, produced and straight behind. The umbones are tumid, incurved and pointed, elevated above the hinge-line, and placed in the anterior fourth of the valve. The lunule is long and narrow, and slopes downwards and forwards. The escutcheon is long and broad, bounded externally by a curved erect ridge, which passes from the posterior edge of the umbo to the postero-superior angle. A very broad bluntly rounded swelling is continued downwards and backwards from the umbo to the postero-inferior angle, separating a depressed and hollowed dorsal slope from the rest of the valve.

The shell is very much curved on itself from above downwards, and much more gibbose posteriorly than in front. There is a well-marked narrow constriction starting at the umbo, and passing directly downwards to the inferior margin.

Interior.—Unknown.

Exterior.—The surface is adorned with well-marked concentric grooves and ridges, narrow and close in the umbonal region, but becoming broader and further apart as they approach the margin. The folds and grooves terminate abruptly along a line at some small distance in front of the oblique swelling, but are represented on the dorsal slope by flattened broad ridges, which become almost obsolete as they reach the upper border. Each concentric ridge is interrupted at the junction of the anterior and middle thirds of the valve, and is narrowed to a vanishing point, the anterior and posterior portions overlapping slightly and inclined to each other at a wide angle, the posterior limb being uppermost. Occasionally complete interruption does not occur, in which case there is a V-shaped bend in the ridge at the same position on the valve.

Dimensions.—Pl. XLII, fig. 10, from the Limestone of Thorpe Cloud, Derbyshire, measures—

Antero-posteriorly	37 mm.
Dorso-ventrally	21 mm.
Elevation of valve	8 mm.

Locality.—England: the Carboniferous Limestone of Thorpe Cloud, Dovedale, and Castleton, Derbyshire.

Observations.—I have erected this species on five specimens from the shell-beds of Thorpe Cloud, all of which exhibit the peculiar arrangement of the concentric grooves and ridges described above. It will be noted that there is an approach to this condition of things in other species of the genus, *e. g. S. variabilis* and *S. argutus*. *S. interruptus* is much more transverse than either of these species, and has, in addition to the interruption, the concentric grooves and ridges much more strongly marked and fewer in number than in any other species.

Sanguinolites clavatus, *R. Etheridge, jun.*, sp., 1876. Plate XL, figs. 7—14; Plate L, fig. 21.

Leptodomus ? clavatus, *R. Etheridge, jun.*, 1876. Ann. Mag. Nat. Hist., ser. 4, vol. xviii, p. 102, pl. iv, figs. 9, 10.
Pandora ? typica, *R. Etheridge, jun.*, 1878. Quart. Journ. Geol. Soc., vol. xxxiv, p. 17, pl. ii, fig. 23.
Sanguinolites abdensis (?), *Kirkby*, 1880. Ibid., vol. xxxvi, p. 586.
Pandora typica (?), *Etheridge, sen.*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 288.

Specific Characters.—Shell small, very inequilateral, transverse, clavate, arched, gibbose anteriorly, compressed and narrowed posteriorly. The anterior end is small, deep, swollen, and with rounded margin. The inferior border is prolonged and convex, much elevated behind, where it rises rapidly to join the posterior border. The posterior border is narrow and truncate, almost straight. The postero-inferior angle is a rounded obtuse angle, and the postero-superior a right angle. The hinge-line is long, nearly straight, but slightly concave upwards. The umbones are gibbose, incurved and pointed, placed in the anterior fourth of the valve, and elevated above the hinge-line. Passing downwards and backwards from the umbo towards the postero-inferior angle is a more or less well-defined ridge, which is often somewhat curved, separating the much compressed and often concave dorsal slope from the rest of the valve. A well-marked angular fold forming the upper margin of the valve passes backwards from the umbo, separating the long escutcheon from the dorsal slope. In front of the oblique ridge the valves are gently convex. Lunule well marked, narrow, and elongate.

Interior.—Few details of the interior are known. The pallial line is entire, and the hinge appears to be edentulous and to have a long rolled edge posteriorly.

Exterior.—The surface is ornamented with concentric striæ and folds of growth, which become less apparent, and bend sharply upwards as they reach the oblique ridge. Shell thin.

Dimensions.—Pl. XL, fig. 7, a specimen from Mr. Kirkby's zone 3, west of Pittenweem (*op. cit.*, p. 586), measures—

Antero-posteriorly	15 mm.
Dorso-ventrally	7 mm.
From side to side	6 mm.

Localities.—England: the Redesdale Ironstone, Redesdale, Northumberland. Scotland: shale above Craigleith Sandstone, Craigleith Quarry, near Edinburgh;

Black Marine shale, Woodhall, Water of Leith; Newton and Knockhill Quarries, Strathkinness, St. Andrews; Drumsheugh, near Dean Bridge; zone 3 of Mr. Kirkby, west of Pittenweem Harbour; all in the Calciferous Sandstone series (Cement-stone group) of Scotland.

Observations.—This species was described by Mr. R. Etheridge, jun., in 1876, under the name *Leptodomus? clavatus*, from crushed examples, and was redescribed in 1878 by the same author as *Pandora ? typica*, the specific name being changed because M'Coy had previously described a shell as *Pandora ? clavata*, 'Synop. Carb. Foss. Ireland,' p. 51, pl. xi, fig. 2. This time better preserved specimens were figured. One of the specimens figured in Mr. R. Etheridge's original paper is preserved in the Collection of the Geological Survey in the Science and Art Museum, Edinburgh, and I refigure it Pl. XL, fig. 7. It is crushed and has been fractured obliquely along the ridge, making the shell appear as if carinated. The figured types of *Pandora ? typica* are not in the same collection; each of these three specimens is stated to be in a private collection. In his remarks on the species Mr. Etheridge says, "The reference to *Pandora* is made exclusively on the close external resemblance this species bears to that genus. I have not seen any of the internal characters, neither can I say whether the shell was inequivalve or not, as it should be if a true *Pandora*." I doubt whether there exist any real anatomical grounds for supposing that shells referable to the genus *Pandora* existed in palæozoic times.

The figures of two species described by M'Coy have some resemblance to *S. clavatus*, namely, *Lutraria elongata* and *Pandora clavata*. The type specimen of the former is not in the Griffith Collection of the Science and Art Museum, and I am unable to trace it. The type specimen of *Pandora clavata* is so poor as to be quite undeterminable, and consequently Etheridge's original specific name has been adopted, it being quite impossible to say to what genus *Pandora clavata* of M'Coy belongs.

S. clavatus has certain affinities with *S. angustatus*, but it is much smaller, the concentric ribs not so regular, and the posterior end is narrowed. This species appears to be confined to the Calciferous Sandstone series in Scotland, and to be one of the earliest, if not the first species of the genus in Carboniferous beds. In England, however, it is present in the Redesdale Ironstone shales at a much higher horizon.

Mr. Kirkby (*op. cit.*), I think, confused the *S. clavatus* and *S. abdenensis* of Mr. Etheridge. The latter is a smoother, more transverse shell, and is found in a series of beds considerably higher than that in which *S. clavatus* occurs: further reasons for this opinion are given in my remarks on *S. abdenensis*, p. 409.

Sanguinolites plicatus, *Portlock*, sp., 1843. Plate XLIV, figs. 9, 11—15; Plate XLV, figs. 1—4.

Sanguinolaria plicata, *Portlock*, 1843. Rep. Geol. Londonderry, p. 433, pl. xxxiv, fig. 18.
— undata, *Portlock*, 1843. Ibid., p. 434, pl. xxxiv, fig. 20.
— transversa, *Portlock*, 1843. Ibid., p. 434, pl. xxxiv, fig. 21.
— plicata, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 100.
— transversa, *Morris*, 1843. Ibid., p. 100.
— undata (pars), *Morris*, 1843. Ibid., p. 100.
Sanguinolites plicatus, *M'Coy*, 1843. Synop. Carb. Foss. Ireland, p. 49, pl. x, figs. 3 *a*, *b*.
— iridinoides, *M'Coy*, 1843. Ibid., p. 49, pl. xii, fig. 1.
— undatus, *M'Coy*, 1843. Ibid., p. 51.
— transversus, *M'Coy*, 1843. Ibid., p. 50.
Sanguinolaria plicata, *Brown*, 1849. Illust. Foss. Conch., p. 219, pl. xc, fig. 19.
— transversa, *Brown*, 1849. Ibid., p. 219, pl. xc, fig. 33.
Pholadomya plicata, *d'Orbigny*, 1851. Prodrome paléontol., vol. i, p. 128.
— iridinoides, *d'Orbigny*, 1851. Ibid., p. 128.
Sanguinolites ? plicatus, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
— iridinoides, *Morris*, 1854. Ibid., p. 223.
— undatus, *Morris*, 1854. Ibid., p. 223.
— ? transversus, *Morris*, 1854. Ibid., p. 223.
— iridinoides, *M'Coy*, 1855. Brit. Pal. Foss., p. 504, pl. 3 f, fig. 11.
Solen signifer, *Eichwald*, 1856. Bull. Soc. Imp. Nat. Moscou, vol. xxix, part 2, p. 579.
— — — — Ibid., part 1, p. 144.
— — — 1860. Lethæa Rossica, p. 1038, pl. xxxix, figs. 9 *a*, *b*.
Sanguinolites plicatus, *Young and Armstrong*, 1870. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 53.
— iridinoides, *Young and Armstrong*, 1870. Ibid., p. 53.
— plicatus, *Armstrong, Young, and Robertson*, 1876. Cat. West. Scottish Foss., p. 55.
— iridinoides, *A., Y., and R.*, 1876. Ibid., p. 55.
— plicatus, *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 313.
— iridinoides, *Bigsby*, 1877. Ibid., p. 313.
— transversus, *Bigsby*, 1877. Ibid., p. 313.
— ? undatus, *Bigsby*, 1877. Ibid., p. 313.
Non — transversus, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 76, pl. xvii, figs. 4, 5.
— plicatus, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.
— iridinoides, *Etheridge*, 1888. Ibid., p. 289.

SANGUINOLITES TRANSVERSUS, *Etheridge*, 1888. Ibid., p. 290.
— UNDATUS, *Etheridge*, 1888. Ibid., p. 290.

Specific Characters.—Shell above the medium size, transversely elongate, oblong, curved from before backwards, compressed, very inequilateral. The anterior end is exceedingly short, compressed, somewhat narrower from above downwards than the rest of the valve. Its border is curved elliptically in the younger stages of growth, but more obtusely rounded in older examples. The inferior border is very long, and slightly convex in the whole of its extent. The posterior border is almost straight obliquely, truncate from above, downwards, and backwards. The postero-inferior angle is bluntly rounded; but the postero-superior has a well-marked obtuse angle. The hinge-line is long, curved by its slight elevation towards the posterior end, so as to be concave along its free border. The umbones are very small, narrow, compressed, pointed, and directed forwards, not raised above the hinge-line, and situated in the anterior sixth of the valve. The upper edge of the valve is formed by a well-marked elongated ridge, erect, formed by the sudden bending of the valve on itself, and this separates the elongate, narrow escutcheon from the rest of the valve. Passing downwards and backwards, obliquely towards the postero-inferior angle is an almost obsolete fold, soon lost on the surface of the valve; it separates the compressed dorsal slope from the rest of the valve. The valve is only slightly convex from before backwards, but more so from above downwards. There is an obscure compression about the middle of the valve. The lunule is narrow and obscure.

Interior.—The anterior adductor scar is deep and round, marked off from the rest of the valve by a ridge; it is placed near the antero-superior angle and surmounted by an accessory muscle-scar, which is smaller, and lies between it and the umbo. The posterior adductor scar is large, shallow, and obscure. Pallial line entire.

The hinge-line is unknown in its anterior part, but posteriorly it is edentulous, and possesses an elongate rolled edge placed at right angles to the valve, and separated from it by a groove. Below and parallel to the hinge-line is an elongate process of shell which leaves a groove in casts; this becomes broader and deeper as it passes backwards, till it becomes obsolete at some little distance from the posterior border.

The interior of the valve is marked with concentric grooves and folds, which are obsolete in front and in the hollow of the dorsal slope.

Exterior.—The surface is covered with fine striæ and rugæ of growth, grouped into concentric folds and rounded ridges, which all follow the contour of the valve. Close, and less well-marked in front, the ridges separate as they pass over the valve, becoming more marked and wider apart; as they reach the oblique fold they are curved upwards obtusely, whence they pass upwards and forwards to terminate in the hinge-line. Shell very thin.

Dimensions.—Pl. XLV, fig. 4, from the Limestone of Lowick, measures—

Antero-posteriorly	145 mm.
Dorso-ventrally	37 mm.
From side to side	12 mm.

Localities.—England : the Carboniferous Limestone of Lowick, and the Redesdale Ironstone, Northumberland. Scotland : Brunston Colliery, Penicuick, ten fathoms below the Linn Spout Limestone, Garpel Water, and Orchard. Ireland: Roughan, Dungannon; Benburb, Tyrone; Ballynascreen and Desertmartin, co. Derry; Ballintrillick; Fermanagh, in calcareous grit and shale; Riddlestown, Limerick.

Observations.—Portlock unfortunately figured as the type of his *Sanguinolaria plicata* a very young shell, so that it is not surprising that M'Coy described the adult form under a different name. The latter author figured the shell twice, and gave a very full and accurate description in his later work, but he does not appear to have observed any but full-grown specimens, for nothing is said about the earlier stages of growth. Probably another reason why the identity of *S. plicatus* and *S. iridinoides* was not recognised is that the large full-grown shells are largely or entirely destitute of shell, and exist as casts of the interior. A fine series of shells is in the Woodwardian Museum, Cambridge, from Lowick, demonstrating the stages of growth and the identity of Portlock's and M'Coy's species. The type of *S. plicatus* is preserved in the Museum of the Geological Survey, Jermyn Street, and I am kindly permitted to refigure it by the authorities (Pl. XLIV, fig. 11). It consists of both valves, with the test preserved, lying flat open in a shaly matrix. Pl. XLIV, figs. 13 and 14, are from Lowick, and represent various stages in the growth of the shell.

I am unable to agree with M'Coy's statement that *S. plicatus* was "slightly gaping at both ends," for the reverse is really the case; although, owing to fossilisation often taking place when the valves were somewhat apart, a false appearance of gaping ends is sometimes shown. With the following remark of M'Coy I so cordially agree that I quote it entire:—"The thick internal ridge below the cardinal margin, which leaves a strong sulcus in the cast, is thickest at the posterior end, and gradually tapers to a point and disappears before reaching the beak, so that it is in no way homologous with the cartilage-ridge of *Edmondia*." This sulcus is well seen in Pl. XLV, fig. 4. There is no evidence of any external ligament in this species, in which character it agrees with most of the species of the genus; and it is possible that this ridge may have served for the attachment of a strong internal ligament, which would be very necessary in such a large shell, entirely destitute of any locking apparatus in the long posterior hinge-line, in order to keep the valves in contact.

There can be little doubt of the propriety of placing the *Sanguinolaria transversa* of Portlock as a synonym of *S. plicatus*. The type specimen ("No. 5" of Portlock), Pl. XLV, fig. 1, is now in the Museum of the Geological Survey, Jermyn Street, and represents a cast of the right valve of a half-grown shell. There is no diagonal ridge as shown in the original figure. Portlock compares *Sanguinolaria transversa* (*op. cit.*, p. 434) with *S. plicatus*, and says, "This is as much depressed as *S. plicata*, and resembles it in form, but the undulations or folds become little more distinct than the ordinary lines of growth." He apparently did not recognise the fact that the type specimen of *S. plicata* had its shell preserved, while that of *S. transversa* was only a cast of the interior. Another of Portlock's specimens is preserved in the same collection, "No. 7" of that author, from shale. This specimen certainly does show that the sulci and rugæ were less well marked, a fact probably accounted for by the muddy waters in which the shell lived (Pl. XLIV, fig. 12).

The figure of *Solen signifer*, Eichwald (*op. cit.*), is probably characteristic of the full-grown shell of *Sanguinolites plicatus*, and must be also placed as one of its synonyms. The shell was obtained from the Carboniferous Limestone of Sloboda, in the Russian government of Toula.

I consider the *Sanguinolaria undata* of Portlock to be a specimen of *S. plicatus* with the external markings very highly accentuated. The two shells seem to be always found together, and no other character except the degree of accentuation of the external ornament can be cited to distinguish them. Portlock (*op. cit.*, p. 598) says, "Amongst some valuable Berwick fossils, obligingly sent me by the Rev. Mr. Jenkinson of Lowick, I find both the species *Sanguinolaria undata* and *S. transversa*. The specimens are perfect, and show that *S. undata* was nearly identical in form with *S. transversa*, but distinguished by the angular folds of the posterior portion of the shell." M'Coy says (*op. cit.*, p. 505), "This shell (*S. iridinoides*) is distinguished from the *S. undata* (Portlock) by that species having numerous strong prominent ridges continued without any visible increase in number or diminution in size across the body of the shell; the anterior side is also much narrower and rounded." As a matter of fact the external markings vary slightly in individual specimens, and a long series of examples shows all degrees of variety in markings between the extremes. I therefore place *Sanguinolaria undata*, Portlock, as a synonym of *Sanguinolites plicatus*. It is curious, therefore, that Portlock has described the young, adult, and another form of the same shell as three distinct species, all of which have been adopted by M'Coy, who also redescribed the adult form under another name.

This species is very common indeed in the Redesdale Ironstone series, but good specimens are rarely found; and shells of *S. plicatus* from this locality are often deformed, owing to incomplete fossilisation, and appear much foreshortened, and may then appear to have characters quite different from those given in the diagnosis.

Sanguinolites tricostatus, *Portlock*, sp., 1843. Plate XLII, figs. 11—15.

Cypricardia ? tricostata, *Portlock*, 1843. Rep. Geol. Londonderry, p. 441, pl. xxxiv, fig. 17.
— — *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 86.
Sanguinolites tricostata, *M'Coy*, 1843. Synops. Carb. Foss. Ireland, p. 50.
Cypricardia tricostata, *Brown*, 1849. Illust. Foss. Conch., p. 199, pl. lxxxi, fig. 13.
Solenopsis tricostata, *de Ryckholt*, 1853. Mélanges paléontol., pt. 2, p. 62, pl. xiv, figs. 7, 8.
Sanguinolites tricostata, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
— — (pars), *M'Coy*, 1855. Brit. Pal. Foss., p. 507.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 313.
Non — — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 84, pl. xv, figs. 14, 15.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.
— — ? *Julian*, 1896. Carbonifère marin de la France Centrale, p. 42, pl. x, fig. 14.
— — *Tornquist*, 1896. Fossilführ. Untercarbon Sudvogesen, ii (Abh. geol. Karte Elsass-Lothr., vol. v), p. 125, pl. xix, fig. 17.

Specific Characters.—Shell of moderate size, inequilateral, transversely oval, moderately gibbose, carinate, with a much-compressed dorsal slope. The anterior end is small, the narrowest portion of the valve in the dorso-ventral diameter, the upper border being much below the level of the umbones. The anterior border is rounded. The inferior border is long, very gently and regularly convex for the greater part of its extent; but, as the posterior edge is approached, the convexity increases rapidly in amount. The posterior end is obtusely rounded, with some approach to an angle where it joins the lower border. The postero-superior angle is very obtuse. The hinge-line is gently arched, and is considerably shorter than the longest diameter of the valve. The umbones are small, narrow, incurved and twisted forwards, contiguous, only slightly raised above the hinge-line, and situated in the anterior fifth of the valve.

Passing from the umbo to the postero-inferior border is an oblique, blunt, angular fold, which marks off the dorsal slope from the rest of the valve. The portion of the valve in front of this fold is convex; but there is a marked oblique shallow compression, starting below the umbo, which becomes broader and shallower as it approaches the inferior margin. Posterior to the ridge the valve is rapidly compressed and flattened, and slightly expanded upwards, forming a comparatively large dorsal slope, marked off above the escutcheon by a well-defined erect angular ridge. The slope is divided into three almost equal parts by two radiating lines more or less pronounced, which pass diagonally across it, and at each of which the valve is slightly bent on itself towards the middle line.

Interior.—The anterior adductor muscle-scar is of fair size, pear-shaped, almost marginal, and bounded on its posterior edge by a slight elevation. The posterior adductor scar is well marked but shallow, rounded. It is placed just below the hinge-line, remote from the posterior margin. The anterior part of the hinge-line is unknown, but the posterior portion is straight, with a rolled margin. The pallial line is entire, remote from the margin.

Exterior.—The surface is ornamented with very fine concentric striæ and lines of growth, some of which are here and there accentuated. At the oblique fold these lines are suddenly bent upwards, and, as they pass, each of the two smaller radiating lines on the dorsal slope becomes bent slightly forwards at a wide angle, thus accentuating these lines.

Shell thin.

Dimensions.—A medium-sized example from Fermanagh (probably the locality where the type of Portlock's shell was obtained), Pl. XLII, fig. 14, measures—

Antero-posteriorly	43 mm.
Dorso-ventrally	18 mm.
Lateral thickening of each valve . . .	8 mm.

Localities.—England: the Carboniferous Limestone of Lowick, and the Redesdale Ironstone series, Northumberland; in black shales below the Millstone-grit of Pule Hill, near Marsden, and Hebden Bridge. Ireland: the Carboniferous Limestone of Carnteel, Tyrone; Drumkeeran, co. Fermanagh; Old Abbey, co. Limerick; Ballinabintry, co. Cork; Bundoran, co. Donegal.

Observations.—I am decidedly of opinion that two distinct shells have been referred to *S. tricostatus*, Portlock, sp., both possessing three radiating lines on the dorsal slope. The differential diagnosis is discussed at length in my observations on *S. striato-granulatus* (p. 393). The type specimen of *S. tricostatus* is preserved in the Museum of the Geological Survey, Jermyn Street, and I am permitted to refigure it by the kindness of the Director-General; and other specimens from the same locality are in the collection of the Geological Survey of Ireland.

This species is fairly abundant in the Redesdale Ironstone series, whence I have obtained shells with portions of the exterior beautifully preserved, but I have never seen any approach to granulation, or the possession of radiating rows of tubercles on their surface.

SANGUINOLITES STRIATO-GRANULATUS, sp. nov. Plate XLII, figs. 16—22.

SANGUINOLITES TRICOSTATUS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., tom. xi, p. 84, pl. xv, figs. 14, 15.

Specific Characters.—Shell oblong, below medium size, diagonally gibbose, very inequilateral, somewhat narrowed posteriorly in the dorso-ventral diameter. The anterior end is very short, compressed, its upper margin excavated by a large lunule, its border rounded. The inferior border is almost straight, produced, meeting the posterior border at an obtuse angle. The posterior border is obliquely truncate from above downwards and backwards, nearly straight, meeting the hinge-line at a well-marked obtuse angle. The hinge-line is arched in front, straight behind, nearly as long as the valve. The umbones are small, narrow, incurved, and contiguous, not much elevated, and placed in the anterior sixth of the valve. A well-marked angular ridge passes obliquely downwards and backwards from the umbones to the postero-inferior angle, separating a comparatively large and compressed, but convex dorsal slope from the rest of the valve. Another low but erect ridge passes from the umbo to the postero-superior angle, separating the dorsal slope from the large, elongate, but shallow escutcheon. The dorsal slope is crossed by two radiating lines. The valve, anterior to the ridge, is somewhat compressed by a broad, oblique, shallow, nearly obsolete sinus.

Interior.—The anterior adductor muscle-scar is very large, pyriform, and occupies the greater part of the anterior portion of the valve. It is bounded behind by a well-marked ridge, which descends nearly to the lower border. The posterior adductor scar is shallow, and placed in the upper margin, remote from the posterior end. Pallial line entire. Hinge normal. The inner surface of the valve is almost smooth with concentric shallow grooves and laminæ, crossed by obsolete radiating striæ. The dorsal slope has one or two radiating grooves.

Exterior.—The surface is ornamented with fine but irregular concentric lines of growth, with an occasional deep sulcus in some individuals, pointing to a temporary cessation of growth from some cause or other. The posterior two-thirds of the valve is covered by radiating lines of small tubercles, present also on the dorsal slope. The dorsal slope is crossed by one or more radiating lines or obsolete ridges. Shell moderately thick.

Dimensions.—Pl. XLII, fig. 19, from the Carboniferous Limestone of Malahide, co. Dublin, measures—

Antero-posteriorly	43 mm.
Dorso-ventrally	20 mm.
From side to side	16 mm.

Localities.—England: the Carboniferous Limestone of Eskerhouse and Hill Stebden, Yorkshire, and Poolvash, Isle of Man; the Redesdale Ironstone, Northumberland. Scotland: the Upper Limestone series of Boghead, and Linn Spout, Dalry; the Lower Limestone series of Craigenglen, Campsie, and Hind Og Glen, Dalry; shore east of Ardross Castle, Calciferous Sandstone series. Ireland: the Carboniferous Limestone of Malahide, co. Dublin.

Observations.—*S. striato-granulatus* has somewhat the shape and general appearance of *S. tricostatus;* but in the very best preserved specimens of the latter species I have never been able to make out any tubercles or granules on the surface. In addition, the escutcheon of *S. striato-granulatus* is very much larger and broader than that of *S. tricostatus.* The posterior end is narrower and more squarely truncate, the hinge-line much longer, and the costæ on the dorsal slope are less well marked. The lines of growth are generally more rugged, and not so fine and regular. The granulations on the surface are very like those found in *Edmondia sulcata, Allorisma sulcata,* and *Tellinomorpha cuneata,* and have the same arrangement; but the absence of escutcheon and lunule at once serves to distinguish the genus *Edmondia* from *Sanguinolites;* and the diagnostic differences between *Sanguinolites* and the other genera have been pointed out above (page 365).

S. Omalii, de Ryckholt, sp., figured by de Koninck, is one of the few species of the genus which is narrower behind than in front; but no mention is made of any radiating lines of tubercles, and the shell is much attenuated behind by the depression of the upper border.

I am of opinion that the specimen which de Koninck has referred to *S. tricostatus* really belongs to the species under discussion. He figures in a diagrammatic sort of way the decussating lines, and describes them as follows (*op. supra cit.*, p. 85):—"Toute la surface est ornée d'un réseau formé de minces plis d'acroissement, quelquefois un peu lamelleux, qui coupent en travers de fines stries rayonnantes à peine perceptibles à la simple vue et produisant aussi une réticulation qui ne m'a été offerte par aucune autre espèce."

M'Coy also seems to have confused the species, for he says, in his remarks on *P. tricostatus* (*op. cit.*, p. 507), "When the periostraca is [are] preserved, rows of minute dots are seen radiating from the beak across the concentric plicæ."

SANGUINOLITES VISETENSIS, *de Ryckholt*, sp. Plate XLIII, figs. 1—4.

PHOLADOMYA VISETENSIS, *de Ryckholt*, 1847. Mélanges paléontol., 1e partie,
pl. x, figs. 1 and 2.
SOLENOPSIS VISETENSIS, *de Ryckholt*, 1853. Ibid., 2e partie, p. 63.
SANGUINOLITES VISETENSIS, *Bigsby*, 1877. Thesaurus Devonico-Carboniferus,
p. 313.
— — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat.
Belgique, vol. xi, p. 80, pl. xv, fig. 7.
? — ROEMERI, *de Koninck*, 1885. Ibid., p. 83, pl. xvi, fig. 12.

Specific Characters.—Shell of medium size, very inequilateral, ovate-oblong, expanded posteriorly, compressed, obscurely keeled. The anterior end is very small, much narrowed from above downwards, and its border elliptical. The inferior border is convex, and descends rapidly at first; but the convexity gradually diminishes, and it joins the posterior border at a well-marked angle, a little larger than a right angle. The posterior border is expanded and almost polygonally cut, joining the upper border at an obtuse angle. The hinge-line is arched in front, depressed, straight, produced, and gradually raised behind. The umbones are small, low, elongate, incurved and twisted forwards, much elevated above the anterior portion, but not above the rest of the valve, and situated in the anterior fifth of the valve. Proceeding downwards and backwards from the umbo to the postero-inferior angle is an obscure blunt fold, which divides the extensive, compressed, and expanded dorsal slope from the rest of the valve. In front of the ridge the valve is compressed, but in the region of the umbones it is somewhat convex. The dorsal slope is crossed by two or three equidistant radiating lines. The lunule is elongate and narrow. The escutcheon is long and narrow.

Interior.—The anterior adductor muscle-scar is pear-shaped, deep, and almost marginal, bounded behind by a curved ridge. The posterior scar is shallow, close to the hinge-line, and remote from the posterior margin. The pallial line is entire, and remote from the margin. The hinge is not known in front, but is edentulous behind, and has a simple rolled margin.

Exterior.—The surface is adorned with fine close concentric lines and striæ of growth, which are bent upwards towards the hinge-line at the oblique ridge, and, as they pass each of the radiating lines on the dorsal slope, become bent forwards at a very obtuse angle. The lines are much coarser in this portion of the shell. There are obscure radiating rows of small tubercles, especially over the dorsal slope.

Dimensions.—Pl. XLIII, fig. 2, from the Carboniferous Limestone of Poolvash, Isle of Man, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	26 mm.
Lateral elevation of valve	8 mm.

Localities.—England: the Upper Carboniferous Limestone of Poolvash, Isle of Man; the Redesdale Ironstone, Redesdale and Bellingham; and Lowick, Northumberland.

Observations.—De Ryckholt, when describing this shell, referred it finally to *Solenopsis*, although he figured it originally under the name *Pholadomya*. De Koninck retained the species under the genus *Sanguinolites*, to which it undoubtedly belongs. There is a close resemblance between *S. visetensis* and *S. tricostatus*. The former is less transverse and comparatively deeper in the dorso-ventral direction, and has a longer and narrow anterior end, and I also agree with de Koninck that the diagonal fold is less pronounced. He thinks that *S. tricostatus* has a reticulate surface, and that this character is absent in *S. visetensis;* but I have shown (see above) reasons for supposing that de Koninck misunderstood the type of *S. tricostatus*, and have called his reticulate shell *S. striato-granulatus*. There are undoubted traces of radiating rows present in the shell from Lowick in the Woodwardian Museum, Cambridge, Pl. XLIII, fig. 4. This species seems to have had at times three distinct radiating lines on the dorsal slope between the oblique fold and the edge of the escutcheon instead of two, which de Koninck thought to be the normal number. I am inclined to think that the number of these radiating lines is not of much specific value, but may depend on crises in the growth of the shell, or extra longevity.

The broad posterior end and the large rounded oblique gibbosity at once serve to separate this shell from *S. tricostatus* and *S. striato-granulatus*.

SANGUINOLITES OBLONGUS, sp. nov. Plate XLIII, figs. 6, 7.

Specific Characters.—Shell above the medium size, oblong, very inequilateral, compressed, carinate, upper and lower borders parallel. The anterior end is short, deep, and compressed; its margin bluntly rounded, passing with a gradual curve into the inferior border, which is almost straight for the greater part of its extent, but curves slightly upwards behind to form a blunted almost right angle with the posterior margin. The posterior border is obliquely truncate from above downwards and backwards, almost straight, as long as the dorso-ventral diameter of the shell about its centre, and forms a well-marked obtuse angle above with the hinge-line. This is short and curved in front, but straight and produced posteriorly.

The umbones are small, depressed, compressed, and elongate, not raised above the hinge-line, and placed near the anterior end of the shell. A well-marked angular ridge passes obliquely downwards and backwards from the umbones to the lower margin of the valve, terminating just in front of the postero-inferior angle, and dividing the valve into two compressed triangular portions, the lower and anterior being somewhat greater than the upper and posterior, which forms the very broad and flattened dorsal slope, subdivided by two obscure radiating lines.

The lunule has not been observed. The escutcheon is long and narrow, and elevated behind, where it is separated from the dorsal slope by an erect elongate ridge.

Interior.—The anterior adductor muscle-scar is large, shallow, and ovate, situated immediately within the anterior margin rather low down. The posterior adductor scar has not yet been exposed. Pallial line simple and remote from the margin. The hinge-line has a rolled edge posteriorly.

Exterior.—The surface is ornamented with numerous very fine concentric lines and striæ of growth, somewhat interrupted on the dorsal slope by two radiating lines. Shell thin.

Dimensions.—Pl. LXIII, fig. 7, in the collection of the Geological Survey Museum, Jermyn Street, measures—

Antero-posteriorly	98 mm.
Dorso-ventrally	45 mm.
From side to side (estimated) . . .	30 mm.

Localities.—England: the Carboniferous Limestone of Park Hill and Castleton, Derbyshire, and Bolland, Yorkshire. Ireland: the Carboniferous Limestone of Millicent, co. Cork.

Observations.—I have founded this species on five specimens, two of which are in the Museum of the Geological Survey, Jermyn Street; two in the Woodwardian Museum, Cambridge; and one very fine example is in the Gilbertson Collection of the British Museum (Nat. Hist.). *S. oblongus* belongs to the *tricostatus* group, having the dorsal fold subdivided by two or three radiating striæ; but in general shape, and in the marked angularity of the ridge, it differs widely from *S. tricostatus*, Portlock, sp. In two of the specimens the oblique ridge is much accentuated by crushing, and curiously both these examples are from Ireland, one example being in the Woodwardian, the other in the Jermyn Street Museum.

The paucity of specimens is to be regretted, and especially the absence of shells in the earlier stages of growth. Indeed, it has occurred to me that these shells may possibly be a giant form of *S. tricostatus*, whose comparative dimensions have been changed by excessive growth. *S. tricostatus* is mostly more gibbose, has a more acute ridge, the posterior end is the deepest part of the shell in a dorso-ventral diameter, and the lines of growth are more strongly marked than in the species under discussion.

It is quite probable that the shell on which M'Coy founded his diagnosis of *S. tumidus*, Phill., sp., belonged to this species, being strongly carinated, with three radiating lines on the posterior slope.

Sanguinolites striato-lamellosus, *de Koninck*, sp., 1842. Plate XLIII, figs. 5, 8—11.

? Gervillia inconspicua, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 212, pl. vi, fig. 13.
Cypricardia striato-lamellosa, *de Koninck*, 1842. Descript. Anim. Foss. Carb. Belge, p. 93, pl. H, fig. 8.
Isocardia transversa, *de Koninck*, 1842. Ibid., p. 94, pl. i, fig. 3; pl. iii, fig. 8.
Cardiomorpha lamellosa, *de Koninck*, 1842. Ibid., p. 110, pl. i, fig. 2.
Cypricardia striato-lamellata, *Bronn*, 1848. Nomencl. Palæontol., p. 387.
— striato-lamellosa, *d'Orbigny*, 1851. Prodrome paléontol., vol. i, p. 130.
Solenopsis striato-lamellosa, *de Ryckholt*, 1853. Mélanges paléontol., partie 2, p. 64.
— tabulata, *de Ryckholt*, 1853. Ibid., p. 65, pl. xiv, figs. 17, 18.
Sanguinolites striato-lamellosus, *M'Coy*, 1855. Brit. Pal. Foss., p. 506.
Cypricardia striato-lamellosus, *Young and Armstrong*, 1871. Trans. Geol. Soc., Glasgow, vol. iii, Supplement, p. 51.
Cf. Pleurophorus tropidophorus, *Meek*, 1875. Pal. Ohio, vol. ii, p. 338, pl. xix, figs. 10 *a*, *b*.
Cypricardia striato-lamellosa, *Armstrong, Young, and Robertson*, 1876. Cat. Western Scottish Foss., p. 53.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 305.
Sanguinolites striato-lamellosus, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 75, pl. xv, figs. 8, 9; pl. xvi, fig. 5.
— tabulatus, *de Koninck*, 1885. Ibid., p. 62, pl. xv, figs. 41—44; pl. xvii, figs. 36, 37.
— vexillum, *de Koninck*, 1885. Ibid., p. 79, pl. xv, figs. 19, 31, 32.
— transversus, *de Koninck*, 1885. Ibid., p. 76, pl. xvii, figs. 4, 5.
— striato-lamellosus, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.
— — *Tornquist*, 1896. Fossilführ. Untercarbon Sudvogesen. ii (Abh., geol. Karte Elsass-Lothr., vol. v), p. 126, pl. xix, fig. 16.

Specific Characters.—Shell of medium size, very inequilateral, compressed, obliquely carinate, transversely rhomb-ovate, its dorso-ventral diameter increasing gradually towards the posterior end. The anterior end is short, compressed, elliptically rounded, narrowed from above downwards, excavated above by a narrow elongate lunule. The inferior border is transverse, very nearly straight. The posterior border is obliquely bitruncate, divided into two almost equal portions by a well-marked angular projection, each part being slightly concave. The postero-superior angle is obtuse and well marked, and the postero-inferior angle, only slightly rounded, is somewhat less than a right angle. The hinge-line is arched in front, straight, produced, and slightly elevated posteriorly; shorter than any antero-posterior diameter. The umbones are small, elongate, compressed, pointed, incurved, contiguous, very slightly raised above the rest of the shell, and placed far forwards. From the umbo a well-marked angular erect ridge passes downwards and backwards obliquely to the postero-inferior angle, separating the compressed and hollowed dorsal slope from the rest of the shell. Another erect angular ridge passes directly backwards, parallel to the hinge-line; and it separates the well-developed, narrow, elongate escutcheon from the dorsal slope. Midway between these two ridges is a third, less marked than the others, which bisects the dorsal slope, and terminates in the angular projection at the centre of the posterior margin. Anterior to the main oblique ridge the shell is gently convex, but is compressed slightly about its centre by a shallow sinus, which extends to and may indent the inferior margin.

Interior.—The anterior adductor muscle-scar is large and oval, deep, and rounded behind by a curved ridge; the posterior scar is very shallow, placed close to the hinge-line, but remote from the posterior end. The hinge-plate is unknown in front, but has a long rolled edge behind. The pallial line is entire. Interior of valve smooth. Shell thin.

Exterior.—The surface of the valves is adorned with concentric lines and lamellæ of growth, close, fine, numerous above in young shells, but becoming gradually coarser and subimbricate as they approach the lower margin. All the lines of growth become much less marked as they pass over the oblique ridge, where they are bent suddenly upwards on themselves, and pass to the superior border, becoming bent somewhat forwards at a very obtuse angle as they cross the oblique line which bisects the dorsal slope.

Dimensions.—Pl. XLIII, fig. 11, from the Carboniferous Limestone of Hill Stebden, Yorkshire, measures—

Antero-posteriorly	41 mm.
Dorso-ventrally	19 mm.
From side to side	13 mm.

Localities.—England: the Carboniferous Limestone of Settle and Hill

Stebden, Yorkshire; Limestone in brook south of Sellet Hall, Westmoreland; Park Hill and Castleton, Derbyshire; Poolvash, Isle of Man; Lowick, Northumberland. The Middle White Limestone, Craig-Fawr, and the Upper White Limestone, Llanymynech, North Wales. Scotland: Upper Limestone series, Shale, below the Linn Spout Limestone, Linn Spout, Dalry, and Craige, near Kilmarnock; Lower Limestone series, shales below the Beith Limestone of Hind Og Glen, Dalry; shale above the Limestone at Ravenscrag Castle, Fife.

Observations.—This species, referred originally to *Cypricardia*, was erected upon a single specimen from the limestone of Visé, Belgium, by de Koninck, *op. cit.* M'Coy redescribed the species under *Sanguinolites* from British localities very thoroughly and accurately, and drew attention to its peculiar characters; but he appears to have met with only small shells, in which the surface markings are much finer and irregular than in full-grown examples. I have had the opportunity of examining the shells from Craige and Lowick, in the Woodwardian Museum, Cambridge, on which this description was founded.

I cannot but think that the *Gervillia inconspicua* of Phillips is described from a specimen of *S. striato-lamellosus;* but the original has completely disappeared, and it is better to allow the name to drop altogether; moreover the figure is taken from a very incomplete example. Shells of this species from Castleton are much less rugged than the full-grown example, Pl. XLIII, fig. 11; but they attained full adult dimensions in this locality. Colour bands are often preserved on Castleton specimens, especially those obtained from the Odin Quarry. Scottish examples, as might be inferred from their occurrence in shales, are much more delicate, their shells thinner and of smaller size. Specimens, however, from all the localities and in all stages of growth possess the peculiar trigonal posterior end.

I am inclined to think that in his later work de Koninck has referred young and half-grown specimens of *S. striato-lamellosus* to new species. Of these *S. vexillum* and *S. tabulatus* are examples, both of which possess the peculiar-shaped posterior end. It is to be noted, however, that, although he describes the posterior end of *S. striato-lamellosus* as "doublement tronquée" in his first diagnosis, and with a misprint of "inférieure" for "postérieure" in his later work, in the figure accompanying the latter a false contour is given to the shell, which is incomplete behind, but has a regularly rounded margin drawn in.

De Koninck states that *S. striato-lamellosus* has greater resemblances to *S. transversus*, another of his species, than any other, but differing in having its surface lamellated; and its line of growth stronger, and being relatively broader from side to side. It possesses the peculiar bitruncate trigonal posterior end characteristic of *S. striato-lamellosus.* De Koninck states that he has compared the Belgian specimen with White and Whitfield's *Cypricardia rigida*, from Iowa, and finds them identical. This species is now referred to *Sphenotus* by Hall, and stated to come from beds of Devonian age. One can understand, knowing de Koninck's views, why he referred shells from Visé and Tournai to different species; but on similar grounds there is much less reason for accepting as identical the shells from Tournai and Burlington, U.S.

There is no doubt, however, that *Sphenotus rigidus*, as figured by Hall, is extremely like *S. striato-lamellosus* in its more regularly striate forms.

SANGUINOLITES STRIATUS, *sp. nov.* Plate XLVI, figs. 1, 2; Plate L, fig. 22.

? SANGUINOLITES PLICATUS, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 589.

Specific Characters.—Shell of moderate size, transversely oblong, very inequilateral, compressed, with a well-marked oblique ridge. The anterior end is short, depressed, and narrow, projecting forwards in front of the umbones, and having a rounded border. The inferior margin is transverse, and, though convex at both ends, is almost straight for the greater part of its extent. The posterior border is slightly expanded, obliquely truncate from above downwards and backwards, and almost straight. It joins the lower border at a blunted right angle, but forms a well-marked obtuse angle above with the hinge-line. The latter is straight, extending backwards. The umbones are small, elongate, incurved, and twisted forwards, placed very close to the anterior end, and not much raised above the posterior part of the shell. Passing obliquely downwards and backwards towards the postero-inferior angle is an angular fold, which marks off the dorsal slope from the rest of the valve. The valve is only slightly convex, and has about its centre an oblique compression, which becomes broader and shallower as it approaches the lower margin. The dorsal slope is compressed and flattened.

Interior.—The anterior adductor muscle-scar is large, rounded, marginal, with a ridge on its posterior margin; the posterior scar longer, very shallow, situated on the dorsal slope immediately below the hinge-line, but remote from the posterior margin. The pallial line is entire, often punctate. The hinge is thickened and rolled behind, but in front is unknown.

Exterior.—The surface is adorned with fine regular concentric lines and striæ of growth, which become almost obsolete on the dorsal slope.

Dimensions.—Pl. XLVI, fig. 2, from Skolie Burn (in the collection of the Geological Survey of Scotland), measures—

Antero-posteriorly . . .	67 mm.
Dorso-ventrally . . .	27 mm.
From side to side . . .	10 mm. (estimated).

Localities.—England: the Redesdale Ironstone Shales, Northumberland. Scotland: Skolie Burn, at Addiebrown Hill, Blackburn; Knockhill Quarry, Strathkiness, St. Andrews. Ireland: Lower Limestone Shale, Newton and Drumline, co. Clare.

Observations.—This species is founded on two specimens from Skolie Burn, a large number of specimens from Strathkiness, in the collection of the Geological Survey of Scotland, and a single specimen from the Lower Limestone Series of Ireland. It is characterised by its narrow transverse form, its comparatively long, narrow, and projecting anterior end, the fine concentric markings of the surface, and the absence of radiating lines on the dorsal slope.

The slab from Strathkiness shows casts of the interior as well as of the exterior, so that all the important anatomical details have been made out.

All the above specimens were at first identified as *S. transversus*, Portlock, sp., but I have shown above, at page 389, that this shell is identical with *S. plicatus;* and this species does not possess an angular oblique ridge, and the ribs and sulci of the surface-markings are much more pronounced.

I think that this is probably the shell referred to *S. plicatus* by Mr. Kirkby (*op. cit.*), as very fine drawings of the shell occur in his MS. book of figures of fossils from the Calciferous Sandstone series of Fife.

SANGUINOLITES LUXURIANS, *de Koninck*, 1885. Plate XLVI, figs. 3—5.

? SANGUINOLARIA GIBBOSA, *Sow.*, 1829. Min. Conch., vol. vi, p. 92, pl. dxlviii, fig. 3.

SANGUINOLITES LUXURIANS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 73, pl. xvi, figs. 1—3.

Specific Characters.—Shell above the medium size, transversely suboval, obliquely gibbose, very inequilateral. The anterior end is short, narrowed from above downwards, its border elliptically rounded, the lower limb of the curve passing rapidly downwards into the inferior margin, which is feebly convex, and apparently almost subparallel with the dorsal border. Posteriorly the lower margin curves upwards to form a rounded acute angle with the posterior border, which projects much beyond the rest of the valve. The posterior border is very obliquely truncate from above downwards and backwards, and shortened by the approach of the upper and lower margins; it forms a well-marked obtuse angle with the upper border. The latter is arched, produced, and elevated behind, much shorter than the lower margin. The umbones are tumid, incurved, and twisted forwards, contiguous, only slightly elevated, excavated in front by a large, deep, and elongate lunule, and situated in the anterior fifth of the valve. A more or less well-marked rounded ridge passes from the umbo obliquely backwards and downwards to the posterior angle, separating a small but rapidly compressed dorsal slope. Anterior to the ridge the valve is convex from above downwards, and before backwards, with a feeble, oblique, broad constriction about its centre, passing from the umbo to the inferior border. The dorsal slope is crossed near its upper part by a feeble radiating line, above which is an elongate groove, which commences as a narrow depression at the umbo, and becoming deeper and broader as it passes backwards, terminates at the posterior margin. The groove is bounded above by an erect fold, the upper edge of which is curved and forms the outer boundary of the large elongate escutcheon. External ligament small and short.

Interior.—Details of the anterior adductor muscle-scars and the hinge are unknown. The posterior adductor muscle-scar is large, shallow, pear-shaped, and placed in the hollow of the dorsal slope, remote from the posterior end. Pallial line entire.

Exterior.—The surface is ornamented with fine concentric striæ and lines of growth, a deeper one here and there interrupting the regularity of the markings, which are more pronounced on the dorsal slope and near the inferior border.

Dimensions.—Pl. XLVI, fig. 4, from Lisbane, co. Limerick (in the collection of the Geological Survey of Ireland), measures—

Antero-posteriorly	74 mm.
Dorso-ventrally	34 mm.
From side to side (estimated) . . .	34 mm.

Localities.—England: the Carboniferous Limestone of Poolvash, Isle of Man. Ireland: the Carboniferous Limestone of Lisbane, co. Limerick, and Ardfodien, co. Kildare.

Observations.—De Koninck founded the species *S. luxurians* on a very perfect and finely grown shell from the Carboniferous Limestone of Tournay, and I am pleased to record the presence of this fine species from two localities in Ireland. Pl. XLVI, fig. 4, is a testiferous example of the left valve; and Pl. XLVI, fig. 5, is the cast of the interior of the left valve. The oval shape, narrowed anterior and posterior ends, oblique gibbosity, and small dorsal slope, without radiating lines, I regard as characteristic features for the diagnosis of the species. De Koninck has placed this species in his group of the *Sanguinolites* having two folds on the dorsal slope, which in this case evidently are represented by the oblique ridge, and the ridge below the groove beneath the upper margin. These ridges, I think, are in no way analogous to the radiating lines of *S. tricostatus*, *S. visetensis*, and *S. oblongus*.

Sowerby described and figured a shell from the Carboniferous Limestone of Queen's County, Ireland, under the name *Sanguinolaria gibbosa* (*op. cit.*). The figured specimen is preserved in the Sowerby Collection of the British Museum (Natural History branch), Cromwell Road; but the fossil is so poor and imperfect as to be almost unidentifiable. I reproduce the shell, Pl. LI, fig. 1, by the kind permission of Dr. Henry Woodward. It may possibly belong to the same species as de Koninck's shell, but perhaps it is far wiser to drop Sowerby's "species" altogether under the circumstances, although it seems to me that the specimen possesses evidence of its belonging to the genus *Sanguinolites*. It may, however, be stated that I found the shell referred to Sowerby's *S. gibbosa* in the Irish Survey Collection, Pl. XLVI, fig. 4. However, had not de Koninck described his *S. luxurians* it might have been possible to retain the earlier species in spite of its problematical nature. The cast, Pl. XLVI, fig. 5, is unfortunately very imperfect, and belongs to a larger shell than either de Koninck's type or the Irish Survey specimen. In this the interior shows little or no evidence of the approach to angularity of the oblique ridge, as seen on the exterior, but I do not think I am mistaken in referring this specimen to *S. luxurians*.

SANGUINOLITES TUMIDUS, *Phillips*, sp., 1836.

SANGUINOLARIA ? TUMIDA, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209, pl. v, fig. 3.
— — *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 100.
SANGUINOLITES TUMIDUS, *M'Coy*, 1843. Synops. Carb. Foss. Ireland, p. 50.
SANGUINOLARIA ? TUMIDA, *Bronn*, 1848. Nomencl. Palæont., p. 1110.
— — *Brown*, 1849. Illust. Foss. Conch., p. 219, pl. xc, fig. 13.
LYONSIA TUMIDA, *d'Orbigny*, 1850. Prodrome paléontol., vol. i, p. 128.
MYACITES TUMIDUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 213.
SANGUINOLITES TUMIDUS, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 59.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 313.
— — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 81, pl. xvi, fig. 6.
— COMPRESSUS, *de Koninck*, 1885. Ibid., p. 82, pl. xvi, fig. 8.
MYACITES TUMIDUS, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 286.

Observations.—Unfortunately the type specimen of *Sanguinolaria ? tumida*, Phillips, has completely disappeared, as was the case with all those which were in that author's private collection. The figure is an altogether impossible one. The original description is as follows: "Transversely elongated, diagonally gibbous; hinge straight; shell imbricated. In the cast the posterior side is marked by strong ridges from the beak (not well seen in this figure, which is reduced from a large Irish specimen)." The species was redescribed by de Koninck as *Sanguinolites* *tumidus*, but curiously enough he saw fit to subdivide Phillips's species, considering that the specimens from Bolland and Ireland must be different. On what reasonable grounds he did so it is impossible to conceive, when the description was so meagre, only one figure had been given, and the type specimen had been lost. The following is a translation of his remarks on his species *S. subplicatus* :—"It seems to me to be very probable that this species is identical with that which is found in Bolland, Yorkshire, which Prof. Phillips has described under the name *Sanguinolaria ? tumida*, and which he identified with an Irish species resembling it, but which is very distinct. This figure has been taken from the latter, and the proposed name should be given to it." Such a method of dealing with the work of previous writers is, of course, quite unwarrantable in the absence of any evidence from actual specimens; the more so when the new species seems to be founded upon a single imperfect specimen. The evidence of the text goes to show that de Koninck was not acquainted with the shell from Bolland; for, under the heading "Localities," he says, "This species (*S. subplicatus*) is rare in the Carboniferous Limestone of Visé, étage III; *it is probable that it exists also* in limestone of the same age at Bolland, Yorkshire." The italics are mine. In the remarks on *S. tumidus* he says, "Having occasion of comparing at Dublin the Belgian with the Irish specimens which are generally referred to the species described by Phillips, I have no doubt of their identity." He goes on to indicate the differential diagnosis between this species and his *S. subplicatus* ; but, as he was so doubtful of the occurrence even of that shell in Bolland, this must have been derived from his observations on Belgian shells. De Koninck's type of *S. subplicatus* is very imperfect and altogether crushed out of shape, and is certainly not accurately represented by the figure, for I happen to possess a plaster-of-Paris cast of the original specimen, made for me by the kindness of Prof. Dupont, and I have come to the conclusion that the shell is only the cast of a very large and fully grown example of *S. tricostatus*.

The reason for such a subdivision of Phillips's species is probably to be found in de Koninck's anxiety to prove his contention as to the exact zonal distribution of all the Carboniferous Limestone fossils of Belgium. He says that *S. subplicatus* occurs in étage III of Visé only, and *S. tumidus* in étage II of Waulsort and Anseremme. He states that Millicent, co. Cork, is Middle Carboniferous, but Bolland belongs to the upper stage, a correlation which the distribution of the Lamellibranchs does not favour; but it is easy to understand that, having laid down the law that each of the Carboniferous Lamellibranchs of Belgium was strictly limited to its own stage, he should apply the same argument to British Carboniferous horizons; and hence, necessarily, Phillips's species (which, by the way, did not come from Millicent) must be a different one from that which occurred in Bolland.

The name *S. subplicatus* was proposed by Kirkby for a shell which I have referred to *Edmondia subplicata* (*supra*, p. 315), from the Calciferous Sandstone series of the Fifeshire coast, in 1880, and 'Quart. Journ. Geol. Soc.,' vol. xxxvi, p. 586, and was therefore pre-occupied and not available for de Koninck's use.

I have been kindly favoured by M. Dupont, of the Musée Royal d'Histoire Naturelle de Belgique, with a plaster cast of de Koninck's *S. tumidus.* It is almost impossible to think that the figure was drawn from the specimen, because the figure appears to be that of a perfect shell; but the specimen is much damaged, incomplete in front and behind, and is half as deep again in the dorso-ventral diameter as the figure shows; and in addition the anterior adductor muscle-scar alluded to in the text, and so well seen in the figure, is quite absent. From an examination of the description it cannot but be recognised that the garbled figure, not the shells, forms the basis of the description. The shell in question seems to me to be rather a large and smooth form of *S. argutus.*

There can be no doubt, under all these circumstances, of the propriety of dropping altogether the species *S. tumidus,* the type specimen being lost, and the secondary types being in such an imperfect and unsatisfactory condition. The specimens in the Irish Survey Collection, probably those alluded to by de Koninck (*vide supra*), labelled *Myacites tumidus,* are too poor for identification, and differ altogether in shape from the shell shown in Phillips's drawing. M'Coy, in re-describing the species, says, " A distinct keel runs from the beak to the posterior angle; " and adds " three obscure radiating ridges on the posterior side," characters common to many species of the genus.

SANGUINOLITES ROXBURGENSIS, sp. nov. Plate XLVI, figs. 12, 13.

SANGUINOLITES? n. s., *Baily*, 1862. Mem. Geol. Surv. Ireland, Expl. Sheet 127, p. 9, fig. 2 *e*.

Specific Characters.—Shell small, inequilateral, transversely elliptical, with an obscure, rounded, oblique fold. The anterior end is short, gently convex; the narrowest part of the valve in the dorso-ventral direction; its border is rounded. The inferior margin is very gently convex, rising posteriorly to curve towards the posterior border, which it meets at a rounded angle. The posterior margin is short, truncate, almost straight, oblique, and meets the hinge-line at a well-marked obtuse angle. The hinge-line is long, arched in front, straight, and somewhat depressed posteriorly. The umbones are small, tumid, incurved, and pointed, only very slightly raised, and placed in the anterior quarter of the valve. Passing obliquely downwards and backwards from the umbo to the postero-inferior angle is a rounded ridge, which separates the compressed dorsal slope from the rest of the valve, which is convex from above downwards and from before backwards. The lunule is small and the escutcheon narrow-elongate, separated from the dorsal slope by an erect curved line.

Interior.—The anterior adductor muscle-scar is small, round, placed just within the antero-superior angle, and has a shallow ridge posterior to it. The posterior adductor scar is large, rough, and placed immediately below the hinge-line, but remote from the posterior end. The pallial line is entire. The hinge-line appears to be edentulous. The interior of the shell is marked by concentric grooves and rugæ.

Exterior.—The surface is ornamented with fine concentric striæ, interrupted here and there by a deeper line, dividing the striæ into groups. Shell thin.

Dimensions.—Pl. XLVI, fig. 12, measures—

Antero-posteriorly	14 mm.
Dorso-ventrally	7 mm.
From side to side	5 mm.

Localities.—Scotland: a bed of black Limestone crammed with Lamellibranchs, Black Burn, New Castleton, Roxburghshire; Calciferous Sandstone series. Ireland: the Carboniferous Limestone of Gillage Bridge, co. Clare.

Observations.—This species is of small size, and occurs in the Scottish locality in large numbers in association with *Modiola MacAdamii.* The oblique fold is not very pronounced, and the shell appears to be somewhat narrowed posteriorly. A shell is figured in the Explanatory Memoir of Sheet 127 of the Geological Survey map of Ireland, which may possibly be identical with *S. roxburgensis.* The type specimen is, however, nothing at all like the original drawing, consisting of a very poor flattened impression of a left valve, incomplete at the posterior end. The woodcut (*op. cit.*) shows a left valve free from the matrix.

Most of the New Castleton specimens are casts, and possess a high polish; but a few possess the shell preserved. The collection of the Geological Survey of Scotland possesses a number of specimens; and Owens College, Manchester, has a fine slab crammed with *Protoschizodus axiniformis*, *Modiola MacAdamii*, and *S. roxburgensis.* Imperfectly freed from the matrix, the shell may often appear to have a pointed posterior, and to possess a Unio-like form.

SANGUINOLITES ABDENENSIS, *R. Etheridge, jun.*, 1877. Plate XLVI, figs. 6—11.

SANGUINOLITES? ABDENENSIS, *R. Etheridge, jun.*, 1877. Geol. Mag., dec. 2, vol. iv, p. 246, pl. xii, figs. 9—11.

? — ABDENSIS, *Kirkby*, 1880. Quart. Journ. Geol. Soc., vol. xxxvi, p. 586.

— ABDENENSIS, *Etheridge, sen.*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.

Specific Characters.—Transversely elliptical, moderately convex, very inequilateral. The anterior end is very short, convexly swollen, and its border is bluntly rounded. The inferior border is produced and almost straight, and parallel to the hinge-line. The posterior border is oblique, subtruncate above, bluntly rounded below. The postero-inferior angle is prominent; the postero-superior angle only slightly marked. The hinge-line is straight, shorter than the greatest length of the shell. The umbones are of fair size, tumid, elevated above the hinge-line, incurved, contiguous, and placed in the anterior third of the valve. Passing obliquely downwards from the umbo to the postero-inferior angle is a very obscure, bluntly rounded swelling, which separates the compressed dorsal slope from the rest of the valve, which is regularly convex. Lunule and escutcheon small, the latter narrow and elongate.

Interior.—The anterior adductor muscle-scar is in its usual position for the genus, and is bounded posteriorly by a slight ridge. Pallial line entire, remote from the margin.

Exterior.—The surface of the valves is ornamented with numerous very fine concentric lines and striæ of growth, which become obsolete on the dorsal slope. On the surface of some valves are numerous small tubercles, very irregularly distributed, both on the convexity of the valve and on the dorsal slope.

Dimensions.—Pl. XLVI, fig. 6, an uncompressed specimen from Corrie Burn, Kilsyth, measures—

Antero-posteriorly	28 mm.
Dorso-ventrally	10 mm.
From side to side	4 mm.

Localities.—Scotland: Corrie Burn, near Cairn Bog, Kilsyth; shore, east of Abden, Kinghorn, Fife; Liddelsdale, in the Lower Carboniferous Limestone group.

Observations.—Mr. R. Etheridge, jun., gave provisionally, as he said, the name *Sanguinolites ? abdenensis* to a shell found very abundantly near Kinghorn, Fife. The specimens from this locality are all much flattened, and often have the two valves lying open on the bedding-planes of the shale. The collection of the

Geological Survey of Scotland contains a tablet with seven specimens of uncrushed and better preserved examples from Corrie Burn, near Kilsyth, some of which I figure, Pl. XLVI, figs. 6, 7. In spite of the fact that this shell is not at all typical of the genus, either in its surface markings or in possessing an oblique ridge, I think that Mr. R. Etheridge, jun., indicated its correct genus. The shell is not an *Edmondia*, for it possesses both lunule and escutcheon.

I am inclined to think that Mr. J. W. Kirkby has confused another species—*Sanguinolites clavatus*—erected by Mr. R. Etheridge, jun., with *S. abdenensis* (which, by the way, he calls *S. abdensis*). He most kindly sent me a series of specimens from the marine bands of the Calciferous Sandstone series of Fife, which he referred to this species, but they undoubtedly all belong to *S. clavatus*. The localities of the two shells belong to very different horizons; for it will be noted that *S. clavatus* is found only in the Calciferous Sandstone series.

Some specimens, Pl. XLVI, figs. 8, 9, show a number of irregularly distributed tubercles on the surface; but I am not satisfied whether they are adventitious or a constant character. Many species of the genus have a tuberculated shell, but in these the tubercles are arranged in definite radiating rows.

This species is not likely to be confused with others of the genus, from most of which it differs by its smooth, unsulcated exterior and the absence of oblique ridge. I do not understand why Mr. R. Etheridge, jun., thought it related to *S. angustatus*, Phill., sp., which has well-marked concentric sulci and ridges over the anterior two thirds of its valves.

SANGUINOLITES SUBCARINATUS, *M‘Coy*, 1851. Plate XLVII, figs. 1—4.

SANGUINOLITES SUBCARINATUS, *M‘Coy*, 1851. Ann. Mag. Nat. Hist., ser. 2, vol. vii, p. 173.
— — — 1855. Brit. Pal. Foss., p. 506, pl. 3 F, fig. 4.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 313.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.

Specific Characters.—Shell below medium size, inequilateral, transversely oblong, tumid, subcarinate. The anterior end is short, narrowed from above downwards, encroached on above by a large and elongate lunule, and its border is elliptically curved. The inferior margin is elongated, very slightly convex, rising posteriorly to form a bluntly rounded postero-inferior angle with the posterior border. The latter is truncate, very slightly oblique from above downwards and backwards, and narrowed by the descent of the posterior part of the upper border. The postero-superior angle is slightly obtuse. The hinge-line is much arched in front, elongate, straight, and somewhat depressed posteriorly. The umbones are large, elongated transversely, tumid, incurved, and pointed, elevated above the rest of the valve, and placed in the anterior third of the shell. Passing obliquely downwards and backwards to the postero-inferior angle is an obtusely rounded swelling, which commences above as a subangular ridge, separating the small but elongate and hollowed dorsal slope from the rest of the valve. A blunt erect ridge passes directly backwards from the umbo to the postero-superior angle, separating the dorsal slope from the wide, elongate, but shallow escutcheon. The part of the valve anterior to the oblique swelling is very convex from above downwards, giving rise to the appearance that the valve is rolled on itself, and from before backwards the convexity is much less, and is crossed by a broad shallow sulcus, which passes from the umbo downwards to the inferior margin in front of the centre.

Interior.—The adductor muscle-scars appear to be normal in position. The anterior part of the hinge is not known; the posterior part is edentulous, and has a rolled margin. The inner surface of the valve is marked by obscure, broad, concentric bands and sulcations, with fine, obsolete, radiating striæ.

Exterior.—The surface is almost smooth, but obsolete concentric wrinkles, folds, and striæ may be observed.

Dimensions.—Pl. XLVII, fig. 3, a specimen from Castleton, Derbyshire, measures—

Antero-posteriorly	. 45 mm.
Dorso-ventrally	. 21 mm.
From side to side	. 18 mm.

Localities.—The Carboniferous Limestone of Lowick, Northumberland; Castleton, Derbyshire; and Poolvash, Isle of Man.

Observations.—The original type of this species is preserved in the Woodwardian Museum, Cambridge, and I am able to figure it, Pl. XLVII, fig. 1, by the kind permission of Prof. McKenny Hughes. It is a left valve, from Lowick, Northumberland, and not a right valve, as depicted in the figure. The species is not at all common, but I have collected specimens from the Carboniferous Limestone of Derbyshire and the Isle of Man.

The narrow, transverse, tumid shape of the shell is very characteristic, and it is not easily mistaken for any other species of the genus. Notwithstanding the peculiar and well-marked characters of this species, it does not seem to have been recognised since M'Coy founded it, for I have not met with this name in any of the lists of fossils from Carboniferous rocks.

SANGUINOLITES OVALIS, sp. nov. Plate XLVI, figs. 14—17.

Specific Characters.—Shell below the medium size, inequilateral, transversely ovate, moderately gibbose. The anterior end is short, compressed, its margin rounded. The antero-superior angle well marked. The inferior border is gently convex, more so behind, where it passes upwards to blend with the posterior margin by a gradual curve. The posterior border is obliquely truncate from above downwards and backwards, very gently convex. The postero-superior angle is obtuse and well marked.

The hinge-line is arched in front, produced and straight behind. The umbones are tumid, small, incurved, placed in the anterior third of the valve, and not much raised. The lunule and escutcheon are well marked, the latter being separated from the dorsal slope by an erect narrow ridge.

The valves are obliquely gibbose from the umbones towards the postero-inferior angle. The dorsal slope is compressed; an almost obsolete diagonal ridge divides a comparatively narrow dorsal slope from the rest of the valve.

Interior.—The interior adductor muscle-scar is large, round, and deep; placed just within the antero-superior angle, and bounded behind by a well-marked ridge, which leaves a slit-like depression in casts. Posterior adductor scar not observed. Pallial line entire, and remote from the margin. Hinge not seen in front, but has an inflated margin behind.

Exterior.—The surface is ornamented with concentric, narrow, close ribs, of irregular size, and often very indistinct, separated by narrow concentric grooves; both of these are even less apparent on the dorsal slope. Fine, close, almost obsolete radiating lines cross these ribs, giving the surface a granular appearance.

Dimensions.—Pl. XLVI, fig. 17, measures—

Antero-posteriorly	27 mm.
Dorso-ventrally	12 mm.
From side to side (estimated) . . .	4 mm.

Locality.—England: from shale in the Millstone-Grit series of Holt Head, near Saddleworth, Yorkshire, probably below the third Grit.

Observations.—This species occurs abundantly in a thin band of shale, at the above-mentioned locality, in association with *Lingula*, *Nuculana stella*, *Posidoniella lævis*, *Schizodus antiquus*, *Nucula gibbosa*, and Ostracods. This locality was worked for fossils by Messrs. Barnes and Holroyd, who have done so much good work in the fossiliferous shales of the neighbourhood; and I am indebted to Mr. Barnes for the material on which I have worked. Unfortunately the shells are nearly always crushed; but, on the other hand, specimens showing the interior as well as the surface-markings can be obtained by carefully splitting the shale.

The generic characters of this species are quite certain; the ridge posterior to the anterior adductor scar, and the entire pallial line, separating it from *Allorisma*, and the presence of an escutcheon and lunule from *Edmondia*. I am not, however, able to refer the shell to any hitherto described species, nor has it any close resemblance to any other species of the genus.

Genus—Solenopsis, *M'Coy*, 1844.

Solen (pars), *Goldfuss*, 1832. In Handb. Geognosie (De la Bèche; translation), p. 531.
— — 1840. Petrefacta Germ., vol. ii, p. 276.
— *Portlock*, 1843. Rept. Geol. Londonderry, p. 441.
Solenopsis, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 47.
? Solenella, *de Ryckholt*, 1847. Mél. Paléontol., 1st part, pl. xi, fig. 17.
Cypricardia (pars), *d'Orbigny*, 1850. Prodrome de Paléontol., pt. i, p. 75.
Lyonsia (pars), *d'Orbigny*, 1850. Ibid., p. 129.
Solen ? *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 224.
— *Swallow*, 1858. Trans. St. Louis Acad. Sci., vol. i, p. 190.
— *Winchell*, 1862. Proc. Acad. Nat. Sci. Phil., p. 422.
Solenopsis, *Baily*, 1862. Expl. Sheet 127, Geol. Surv. Ireland, p. 9.
Clidophorus, *Geinitz*, 1866. Carb. u. Dyas in Nebraska, p. 25.
Solenopsis, *Hayden*, 1872. U.S. Geol. Surv. Nebraska, p. 223.
— (pars), *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 318.
— *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 88.
— *Fischer*, 1887. Man. de Conchyliologie, p. 1112.
— *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 291.
— *Miller*, 1889. N. Amer. Geol. and Palæontol., p. 512.
— *Beushausen*, 1895. Abh. Königl. Preuss. Geol. Landesanstalt, Heft 17, p. 216.

Generic Characters.—Shell small, narrow, very inequilateral; posterior end narrowed and produced, compressed. Umbones small, inconspicuous, and placed very far forwards, with an obscure swelling passing from the umbones to the postero-inferior angle.

Interior.—Anterior adductor muscle-scar round or ovate, deep, with a small accessory scar above it. Posterior adductor scar very flat, obliquely oval. Mantle-line entire. Ligament external.

Exterior.—The surface is covered with fine concentric lines and striæ of growth.

Observations.—This genus was established by M'Coy to receive a single species, *S. minor*, but the genus has been adopted by both European and American palæontologists. Beushausen has given a longer and more complete diagnosis than that of M'Coy (*op. cit.*, p. 217), and this author describes the interior, some details of which I quote on his authority, as I have not been able to see a complete cast of the interior in British Carboniferous specimens. Three species are described by him from Devonian rocks, and he considers it possible that *Cultellus rectus*, Salter, from Ludlow rocks, may also belong to the genus.

Two species of the genus only appear to be present in Carboniferous rocks of Great Britain, and in Belgian rocks of this age de Koninck has also shown the presence of one, a single fragment, which he refers to *S. pelagicus*, Goldfuss, having been obtained. *Solenella orbitosa*, founded by de Ryckholt on a very incomplete shell, and doubtfully referred by de Koninck to *Solenopsis*, is, I think, far too fragmentary for the foundation of a species, and too obscure even to speak with certainty as to its generic affinities, but it probably should be referred to the species under discussion. Beushausen proposes to place the genus in a family *Solenopsidæ;* but I think the affinity to *Sanguinolites* is close enough to place them in the same family.

Fischer (*op. cit.*, p. 1112) says, "The shell has the form of *Sphenia*, and is very much elongated;" but the first part of this observation is not easily reconciled with the diagnosis of this genus which he gives at p. 1122 of his work, or with the figure of the type species, *Sphenia Binghami.*

The shell of *Solenopsis* is quite distinct from *Solen* or *Palæosolen*, both in general form and the absence of gaping ends. It undoubtedly is far more closely allied to *Sanguinolites.*

SOLENOPSIS MINOR, *M'Coy*, 1844. Plate LI, figs. 3—5.

SOLEN PELAGICUS, *Portlock*, 1843. Rep. Geol. Londonderry, p. 441, pl. xxxvi, fig. 4.
SOLENOPSIS MINOR, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 47, pl. viii, fig. 2.
SOLEN ? PELAGICUS (SOLENOPSIS MINOR), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 224.
LYONSIA MINOR, *d'Orbigny*, 1850. Prodrome de Paléontol, pt. i, p. 128.
SOLENOPSIS PELAGICUS, *Baily*, 1862. Expl. Sheet 127, Geol. Surv. Ireland, p. 9, fig. 2 *d*.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 315.
— — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 89, pl. xv, fig. 26.
— — *Etheridge*, 1888. Brit. Foss., pt. i, Palæozoic, p. 291.

Specific Characters.—Shell small, very inequilateral, transversely elongate, lanceolate; narrowed posteriorly by the approach of the upper and lower borders, very feebly swollen. The anterior end is short, but the deepest part of the shell from above downwards, closed, its border rounded. The inferior margin is long and gently convex; the posterior narrow and bluntly curved, the hinge-line long, and almost straight. The umbones are small, very inconspicuous, and placed very far forwards, but not terminal. Passing backwards and downwards from the umbo to the postero-inferior angle is an oblique, more or less well-marked rounded ridge, which separates the long narrow dorsal slope from the rest of the valve, which does not show any sulcation.

Interior.—The anterior adductor scar is small, and placed immediately within the antero-superior angle. The hinge-line seems to have been thickened posteriorly, and to leave a long narrow groove in casts.

Exterior.—The surface is ornamented with fine lines and striæ of growth.

Dimensions.—Pl. LI, fig. 3, the type specimen of M'Coy's *Solenopsis minor*, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally	7 mm.

A large specimen from the Knife Scar Limestone north of Shap, Pl. LI, fig. 4, measures—

Antero-posteriorly (probably incomplete) . .	53 mm.
Dorso-ventrally	15 mm.

Localities.—England: quarry in the Knife Scar Limestone a mile north of Shap village, Westmoreland; Carboniferous Limestone of Thorp Cloud, Derbyshire. Ireland: in gritty Limestone, Clogher; Drumreagh; Dungannon; co. Tyrone; Ballyduff, river Bunnow, King's Co.

Observations.—The type of M'Coy's *Solenopsis minor*, Pl. LI, fig. 3, is preserved in the Museum of Science and Art, Dublin; and I am kindly permitted to refigure the specimen, which consists of a right valve, a little imperfect at the antero-inferior angle. The type of Portlock's *Solen pelagicus* is in the Jermyn Street Museum, Pl. LI, fig. 5.

Most authors have considered M'Coy's shell to be identical with *S. pelagicus*, Goldfuss, but this is a much larger shell with a strong angular oblique ridge, and a well-marked sulcus from the umbo to the inferior border; moreover it occurs in beds of Devonian age.

De Koninck discusses the question of the locality of Goldfuss's type, pointing out that in 1832 Ratigen, near Dusseldorf, and in 1840 Eifel were respectively given as the sources of the specimen by its author; and he says, "For my part I have no doubt that the example figured by Goldfuss comes from the Carboniferous Limestone of Ratigen, and that the species should be erased from the list of Devonian shells."

Beushausen (*op. cit.*) points out that the specimen figured by de Koninck from

Visé differs from that of *S. pelagicus,* Goldfuss; but, on the other hand, he thinks it does not belong to *S. minor.* I am of opinion, however, that it is the full-grown example of this species.

Baily (*op. cit.*) gives a figure of a small example of this species from King's Co. He says the beds consist of "dark blue shales with limestone bands full of shells, the blue shales containing bivalve shells;" and he states that *Nuculana attenuata* and *Sanguinolites plicatus,* and a shell which I refer to *S. roxburgensis,* occur with it. Pl. LI, fig. 4, is a specimen from the lowest bed of limestone but one in the Shap district, and I take it to be a full-grown specimen (a cast of the interior) of *S. minor.* This specimen shows the anterior adductor muscle-scar and a groove to receive the thickened hinge-plate. The absence of oblique ridge, and the sulcus beneath the umbo, separate this shell from *S. pelagicus,* Goldfuss, with which it agrees more in size than any specimen previously figured from British Carboniferous rocks.

SOLENOPSIS PARALLELA, sp. nov. Plate XLIV, fig. 10; Plate LI, figs. 2, 2 *a.*

Specific Characters.—Shell below medium size, compressed and flattened, very inequilateral, dorsal and ventral margins almost parallel; posterior end not narrowed; anterior end very short, compressed; almost as deep from above downwards as the posterior end; its margin rounded; passing with a regular curve into the inferior border, which is straight and very long, meeting the posterior border at a bluntly rounded angle. The posterior border is oblique, truncate from above downwards, almost straight, making a well marked but slightly obtuse angle with the hinge-line. The superior border is straight and elongate. The umbones are small and inconspicuous, compressed, directed forwards, scarcely elevated, and placed very far forwards. A very obscure oblique line passes downwards and backwards from the umbo to the posterior inferior angle, separating a comparatively large flattened dorsal slope from the rest of the valve, which is regularly but very gently convex.

Interior.—The anterior adductor muscle-scar large, well marked, triangular in shape, and placed in the anterior and upper part of the umbonal hollow, remote from the margin; the posterior is very shallow and inconspicuous, mantle-line entire. The interior of the shell shows fine and close lines of growth, which terminate at the oblique line; the hollow of dorsal slope shows flattened obsolete grooves and ridges. In front, fine radiating striæ pass from the umbones towards the lower border. Hinge edentulous posteriorly, with a rolled thickened margin, leaving a groove in casts.

Exterior.—The surface is ornamented in the same way as the interior. Shell very thin.

Dimensions.—Pl. XLIV, fig. 10, a specimen from the Limestone of Lowick in the Woodwardian Museum, measures—

Antero-posteriorly	38 mm.
Dorso-ventrally	11 mm.
From side to side	4 mm.

Localities.—England: the Limestone of Lowick, Northumberland. Scotland: first Limestone on the shore east of Kinghorn, Fife, Lower Limestone group.

Observations.—At first sight it might be thought that the shell figured in Pl. XLIV, fig. 10, was the young of *S. plicatus;* but apart from great differences in the comparative measurements, the position of the anterior adductor muscle-scar, so far backwards and quite in the hollow of the umbones, at once makes it certain that the shell belongs to a different genus.

This species has somewhat the characters of *Palæosolen,* Hall, but the umbones are not placed so far forwards as in that genus; on the other hand the general shape of the valve is rather more like the type of *Palæosolen* than of *Solenopsis.*

S. parallelus is at once distinguished from *S. minor* by the absence of narrowing of the posterior end of the approach of its upper and lower borders.

Solenopsis vetusta, Goldfuss, from the Stringocephalenkalk of Gerolstein, has a close affinity to *S. parallela,* but its lower border is much more convex. The shell of *S. vetusta,* figured by Beushausen, 'Abl. Königl. Preuss. Geol. Landesanstalt,' Heft 17, n. f.; Die Lamell. des rheinischen Devon, pl. xviii, fig. 3, has even more resemblance than Goldfuss's figure.

At present I have only been able to examine a few specimens of the species, one of which from Lowick is in the Woodwardian Museum, Cambridge, and the others are in the Museum of the Geological Survey of Scotland; the latter being very small and young specimens.

Allorisma, *King*, 1849.

Hiatella, *Fleming*, 1828. Hist. Brit. Anim., p. 461.
Venus, *Phillips*, 1830. Geol. York., pt. 1, p. 209.
Sanguinolaria, *Portlock*, 1843. Geol. Rep. Londonderry, p. 434.
Posidonomya, *Portlock*, 1843. Ibid., p. 745.
Sanguinolaria (pars), *Morris*, 1845. Cat. Brit. Foss., p. 100.
Allorisma, *de Verneuil*, 1845. Géol. Russie, vol. ii, Paléont., p. 296.
    — *Morris*, 1845. In Strzelecki, Phys. Desc. New South Wales, p. 270.
    — *King*, 1849. Monogr. Perm. Foss., p. 196.
Myacites, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 213.
Non Allorisma, *Shumard*, 1855. Rep. Geol. Surv. Missouri, pt. 2, p. 206.
Sanguinolites (pars), *M'Coy*, 1855. Brit. Pal. Foss., p. 507.

Myacites, *Woodward*, 1856. Manual Mollusca, p. 496.
Allorisma, *Shumard and Swallow*, 1858. Trans. Acad. Sci. St. Louis, vol. i, p. 210.
— *Meek and Hayden*, 1858. Proc. Acad. Nat. Sci. Philad., p. 263.
— *M'Chesney*, 1859. Trans. Chicago Acad. Nat. Sci., vol. i, p. 56.
— *Eichwald*, 1860. Lethæa Rossica, p. 1037.
— *Swallow*, 1860. Trans. Acad. Sci. St. Louis, vol. i, p. 656.
Myacites, *Salter*, 1861. Mem. Geol. Surv. Gt. Brit., Iron Ores, pt. 3, p. 221.
Allorisma, *Meek and Hayden*, 1865. Smithsonian Contrib. Knowl. Pal. Upper Missouri, vol. xiv, p. 36.
— — 1868. Geol. Surv. Illinois, vol. iii, p. 538.
— *Swallow*, 1868. Trans. Acad. Nat. Sci. St. Louis, vol. ii, p. 95.
— *Meek and Worthen*, 1869. Proc. Acad. Nat. Sci. Philadelphia, p. 171.
— *Meek*, 1871. Ibid., p. 167.
— *Hayden*, 1872. Final Rep. U.S. Geol. Surv. Nebraska, p. 221.
Non — *Meek and Worthen*, 1873. Geol. Surv. Illinois, vol. v, p. 585.
— *White*, 1875. Rep. Geog. and Geol. Exp. and Surv. W. of 100 Merid., pt. 1, vol. iv, p. 155.
Non — *Meek*, 1875. Rep. Geol. Surv. Ohio Pal., vol. ii, pt. 2, pp. 309, 311, 312, and 344.
— *F. Römer*, 1876. Lethæa Geognostica, pt. 1, pl. xliv, fig. 2.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 295.
— *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 277.
Sanguinolites (pars), *Etheridge*, 1888. Ibid., p. 289.
Allorisma (pars), *Miller*, 1889. N. Amer. Geol. and Palæontol., p. 459.
Non — *Worthen*, 1890. Geol. Surv. Illinois, vol. viii, p. 132.
— (pars), *Keyes*, 1893. Rep. Geol. Surv. Ohio, vol. vii, p. 475.
Non Allorisma, *Beushausen*, 1895. Abh. Kön. Preuss. Geol. Landesanstalt., n. F., Heft 17, p. 250.

Generic Characters.—Shell transverse, oval, equivalve, very inequilateral. Anterior border of valve continuous with the anterior edge of the umbo. Bluntly rounded in front and behind, posterior end somewhat broader than anterior. No oblique ridge. Lunule large, depressed; escutcheon large. Valves marked by a broad but shallow sinus at the junction of the anterior and middle thirds.

Interior.—Adductor muscle-scars shallow and inconspicuous. Pallial line sinuated. Inner surface marked by concentric grooves and ribs. Hinge simple, edentulous.

Exterior.—Surface ornamented by simple concentric ribs and sulci, crossed by radiating rows of small tubercles; the dorsal slope almost smooth.

Observations.—This genus has been much misunderstood, owing to its close resemblance in external character to *Edmondia* on the one hand, and to *Sanguinolites* on the other; from both of which it is at once separated by the possession of a well-marked and deep pallial sinus, as pointed out by King. Unfortunately the state of preservation does not always allow this character to be observed. King found the genus to be present in faunas of Carboniferous and Permian age. Beushausen has referred certain Devonian species to the genus; but, judging from his figures, his shells cannot belong to the genus in question, and he admits that in no single case was a pallial sinus discovered in any of his specimens. In common with *Edmondia*, *Sanguinolites*, and *Tellinomorpha*, *Allorisma* possesses a beautifully tuberculated surface. It is also markedly ribbed and sulcated; but the ribs are simple, and not, as in *Edmondia* and *Sanguinolites*, compound or irregular. In addition, the strongly marked oblique ridge of the latter genus is absent, while *Edmondia* is distinguished at once by the absence of lunule and escutcheon, and by the presence of the ossicle within the umbo. Another anatomical difference between the two genera is the absence of the well-marked ridge behind the anterior adductor muscle-scar, always seen in *Sanguinolites*. *Allorisma* has a strong affinity to the other species of the family *Coelonotidæ* (*Grammysiidæ* of authors), and, notwithstanding the presence of a well-marked pallial line, I think may be justly included within it, just as *Yoldia* is included in *Nuculidæ*.

I was for a very long time unable to make out the pallial sinus, but have entirely satisfied myself of its presence in all the species but one, *A. Ansticei*, which I have included in the genus. M'Coy denied the presence of a pallial sinus in King's shells (*op. cit.*, p. 276), and I was so doubtful of the fact, until the last eighteen months, that in Part I of this Monograph, p. 25, I expressed a doubt of King's observation. I may say, however, that of all workers on the bivalve shells of Carbo-Permian times, Professor King was by far the most accurate and scientific observer, and the majority of genera and species established by him are good. It was King who discovered the hinge in *Carbonicola*, the ossicle in *Edmondia*, and the pallial sinus in *Allorisma*, characters of the utmost importance for the correct understanding of each of these genera.

As far as I can ascertain at present, *Allorisma* is (as King has observed, *op. cit.*, p. 197) the oldest form of sinu-pallial shell known, but it possesses no character in common with the *Anatinidæ*, to which family this genus has generally been referred. *Tellinomorpha*, de Koninck, has, however, a much nearer external appearance to *Anatina*, but as yet I have not been able to make out that it possesses a sinuated pallial line; but, reasoning from analogy, I consider it extremely probable that it has this character. Fleming's reference to *Hiatella*, a synonym of *Saxicava*, cannot, of course, be accepted.

American palæontologists have recognised the genus *Allorisma* in Carboniferous rocks of North America. Having been able to study one of the American species, *A. subcuneatus* of Meek and Worthen, I have been able to make out that it possesses a sinuated pallial line. This species I can see no reason for separating from *A. maxima*, Portlock, sp., of which I have considered it a synonym.

Beushausen (*op. cit.*) compares the genera *Allorisma* and *Leptodomus;* but he does not seem to be aware that M'Coy took a totally different type for each of his two descriptions of the latter genus, as I have shown *antea*, pp. 228 and 379. Naturally there is, as I have shown above, a certain amount of similarity between *Sanguinolites* (to which the second type of M'Coy's *Leptodomus* undoubtedly belongs) and *Allorisma.*

Some of the shells now referred to *Allorisma* have been occasionally referred to *Myacites*, Schlotheim, which genus certainly has many characters in common with *Allorisma*, especially in external characters, possessing concentric ridges and grooves covered with minute granules; and the same may be said of allied genera —*Arcomya*, *Pleuromya*, and others. *Allorisma* differs, however, from its Jurassic congeners in being much longer, more inequilateral, having a large lunule and escutcheon, and an edentulous hinge, and not gaping so widely, if at all. It is not at all improbable that the Palæozoic *Allorismæ* were ancestors of the allied tuberculated Jurassic Lamellibranchs. *Tellinomorpha*, however, has a much closer resemblance to Jurassic forms.

ALLORISMA MAXIMA, *Portlock*, sp., 1843. Plate XLVII, figs. 5—7 *a*.

SANGUINOLARIA MAXIMA, *Portlock*, 1843. Rep. Geol. Londonderry, p. 434, pl. xxxvi, figs. 1 *a*, *b*.
SANGUINOLITES CLAVA, *M'Coy*, 1851. Ann. Mag. Nat. Hist., 2nd ser., vol. vii, p. 172.
— MAXIMUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
— CLAVA, *M'Coy*, 1855. Brit. Pal. Rocks and Fossils, p. 504, pl. 3 F, fig. 12.
ALLORISMA SUBCUNEATA, *Meek and Hayden*, 1858. Proc. Acad. Nat. Sci. Philadelphia, p. 263.
— — — 1865. Smithsonian Contrib. Knowl., No. 172, Pal. Upper Missouri, p. 37, pl. i, figs. 10 *a*, *b*.
— — *Hayden*, 1872. Report U.S. Geol. Surv. Nebraska, p. 221, pl. ii, figs. 10 *a*, *b*.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 296.
SANGUINOLITES MAXIMUS, *Bigsby*, 1878. Ibid., p. 313.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.
— CLAVA, *Etheridge*, 1888. Ibid., p. 289.
— SUBCUNEATUS, *Miller*, 1889. N. Amer. Geol. and Palæontol., figs. 768, 769, p. 460.

Specific Characters.—Shell above medium size, transversely elongate, slightly arcuate, clavate, gibbose anteriorly, compressed and somewhat expanded posteriorly, and slightly narrowed from above downwards; very inequilateral. The anterior end is very short, but deep and swollen; its margin bluntly rounded. The inferior margin is convex, especially behind, where it rises to meet the posterior border, passing into it without any approach to angulation. The posterior margin is narrowed, subtruncate, rounded, and joins the hinge-line at a more or less well-marked obtuse angle. The superior border is nearly as long as the shell, arched in front; straight, produced, and slightly depressed posteriorly. The umbones are large, gibbose, incurved, pointed, contiguous, slightly raised, placed very far forwards, and excavated in front by a broad ovate lunule. The escutcheon is long and broad, bounded externally by erect angular ridges, which form the dorsal edges of the valve. The valves are very much swollen in front, but rapidly compressed behind. There is an almost obsolete, oblique, broad compression to be noticed in front of the middle of the valve, best seen near the lower margin. An oblique gibbosity, gradually diminishing, passes downwards and backwards from the umbones towards the postero-inferior angle.

Interior.—The anterior adductor muscle-scar is very large, pear-shaped, striated from before backwards, especially below, and occupies nearly the whole of the anterior part of the shell. It is bounded behind by a ridge, which leaves a groove in casts. The posterior muscle-scar is large and shallow, striated posteriorly from above downwards, and placed just below the upper margin, occupying part of the thickened elongate ridge, and remote from the posterior border. The pallial line is markedly and deeply sinuate, the sinuation being very narrow and angular; its margin often marked by a row of tubercles.

The interior of the shell is marked by concentric grooves and ridges; but the posterior upper portion is almost smooth. Parallel to, but below the upper margin is a broad well-marked thickening, which becomes obsolete near the posterior margin; it is indicated by a groove in casts.

Exterior.—From observation of American specimens the shell is covered by broad concentric ribs and sulci, which become obsolete over the dorsal slope; and the ribs are often, and especially near the lower border, covered with concentric striæ.

Dimensions.—Pl. XLVII, fig. 7, a specimen in the collection of Mr. J. G. Goodchild, from the Carboniferous Limestone near Llangollen, measures—

Antero-posteriorly	129 mm.
Dorso-ventrally	50 mm.
From side to side	39 mm.

Localities.—England: the Limestone of Howick, Northumberland. Wales: the Upper Grey Limestone of Llangollen, and Puffin Island, Anglesea, N. Wales. Scotland: the Carboniferous Series of Brunstane. Ireland: in the light-coloured gritty Limestone at Donaghenry, and Donaghrisk, co. Tyrone.

Observations.—The type specimen of *Sanguinolaria maxima*, Portlock, is fortunately preserved in the Museum of the Geological Survey at Jermyn Street, and I am permitted to refigure it by the kindness of Sir A. Geikie, Pl. XLVII, fig. 5. There can be no doubt that this fragment is the anterior part of the shell described afterwards by M'Coy (*op. cit.*) as *Sanguinolites clava*, and therefore this name must be discarded in favour of the earlier one. M'Coy seems to have noted the resemblance between his shell and Portlock's species, for he states, "The only approximation to this species published that I know is an indeterminate fragment of one end of a shell called *S. maxima* by Portlock, 'Geol. Rep.,' t. xxxvi, p. 11, which is flatter, with smaller beaks, a more truncate anterior end, etc.," the "etc." not being more fully indicated. I have compared the type specimens, and am unable to appreciate the differences described by M'Coy; but probably he was basing his opinion on a not very perfect figure, and had not examined Portlock's type. Owing to the fact that M'Coy's specimen was incomplete posteriorly, the sinuated pallial line was not observed. The sinuation, though large in amount, is very slightly indicated, especially with respect to its upper limb; Pl. XLVII, fig. 7, a fine specimen, in the possession of Mr. J. G. Goodchild, F.G.S., shows the pallial sinus very well indeed.

I have been able to compare several specimens of the North-American shell, *A. subcuneata*, with *A. maxima;* and, being unable to see any difference between them, I have placed Meek and Worthen's name among the synonyms. Meek and Worthen quite recognised the possibility of the two species being identical; for in their remarks on the species (*op. cit.*, 1865, p. 38) they say, "This species is very closely allied to *Sanguinolites clava* of M'Coy, and may possibly prove to be identical when a direct comparison of specimens can be made. Those we have yet seen of the Kansas fossil differ from M'Coy's figures in being straighter on the dorsal margin, and more produced as well as more narrowly rounded in the antero-ventral region. Their concentric undulations are also more obscure, and the lunule-like depression in front of the beaks less distinctly defined in our shell." M'Coy's figured specimen was very incomplete, the posterior fourth being wanting, so that it would be impossible to postulate anything as to the dorsal margin, its extent and character. I believe the difference in the character of the concentric undulations is due to comparison of the external and internal casts of the species.

A. maxima is a very rare shell in British Carboniferous rocks, and of very limited distribution. At present it has not been found in the Carboniferous rocks of the Pennine system. The majority of the specimens, and all the perfect ones, come from two localities in North Wales. Meek and Worthen obtained their specimens from the coal-measures of Kansas, U.S.A.

ALLORISMA SULCATA, *Fleming*, sp., 1828. Plate XLVIII, figs. 3—11.

HIATELLA SULCATA (pars), *Fleming*, 1828. Hist. Brit. Anim., p. 462.
VENUS ELLIPTICA, *Phillips*, 1836. Geol. York., pt. ii, p. 109, pl. v, fig. 7.
POSIDONOMYA TRANSVERSA, *Portlock*, 1843. Geol. Rep. Londonderry, p. 745, pl. xxxviii, fig. 9.
ALLORISMA SULCATA, *King*, 1849. Monogr. Perm. Foss., in foot-note, p. 198.
MYACITES SULCATA, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 213.
SANGUINOLITES SULCATUS, *M'Coy*, 1855. Brit. Pal. Foss., p. 507.
MYACITES SULCATA, *Salter*, 1861. Mem. Geol. Surv. Gt. Brit. Iron Ores, pt. 3, p. 221, pl. i, fig. 28.
ALLORISMA SULCATA, *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 295.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 277.

Specific Characters.—Shell of only medium size, transversely oblong, moderately gibbose, very inequilateral, gaping slightly behind. The anterior end is short, only projecting a little in front of the umbones, gradually compressed, narrowed from above downwards at the expense of its antero-superior part; its margin regularly rounded, passing with a continuous curve into the inferior border, which is only slightly convex as a whole, and distinctly sinuous, in front of its middle point. The convexity increases posteriorly, and passes gradually into the regularly but bluntly curved posterior border, which makes a more or less well-marked obtuse angle with the hinge-line. The upper border is somewhat shorter than the transverse diameter of the valve. It is much arched in front, but is straight posteriorly, and may even be slightly elevated at the extreme postero-superior angle. The umbones are small, gibbose, hardly raised, pointed, curved inwards and forwards, and placed far forwards. The lunule is elongate and depressed, excavating the umbones anteriorly. The escutcheon is long, deep, and narrow, bounded externally by a slightly curved, elevated, angular ridge, which separates the escutcheon from the dorsal slope.

The valves are convex in the umbonal region, and become compressed gradually towards the margins. There is a well-marked compression which passes from below the umbones to the inferior margin, becoming broader and deep, and making the inferior margin somewhat sinuous. The dorsal slopes are compressed, especially immediately below the erect dorsal margin, where there is an elongate groove, which passes from the umbonal region to the postero-superior angle. Proceeding downwards and backwards from the umbones to the postero-inferior angle is a very obscure, almost obsolete, rounded ridge; an obscure curved ridge also passes from the umbo downwards and forwards across the upper part of the anterior portion of the valve to the anterior margin.

Interior.—The anterior adductor muscle-scar is round and shallow; the posterior scar, pear-shaped and large, is placed immediately below the hinge-line, remote from the posterior end. A few specimens show indications of a deep pallial sinus. The inner surface of the shell had concentric grooves and ridges, much as on the external surface, but not so sharply cut.

Exterior.—The surface is ornamented with regular, distinct, simple grooves and ridges, which follow the contour of the valve, the ridges and sulci being of almost equal width.

In well-preserved specimens the shell is covered by radiating rows of minute tubercles, much more apparent on the posterior moiety of the valve and the dorsal slope. Shell very thin.

Dimensions.—Pl. XLVII, fig. 8, a specimen from Beith, Ayrshire, measures—

Antero-posteriorly	62 mm.
Dorso-ventrally	30 mm.
From side to side	22 mm.

Localities.—England: the Redesdale Ironstone, and Lowick, Northumberland; under the Farewell Rock of Glan Rhymney and Beaufort, South Wales; also 500 feet below the third Millstone Grit, Congleton Edge, Cheshire. Scotland: the Upper Limestone Series at Garngad Road, Glasgow; the Lower Limestone Series of Beith. Den Quarry, Kincaple, near St. Andrews; Newtown Quarry, Knockhill; Billowness, zone 8 of Mr. Kirkby, Fife, Calciferous Sandstone series; Shore under Round Tower, St. Monans, Fife, Carboniferous Limestone series. Ireland: in Shale, co. Fermanagh.

Observations.—This species has been surrounded with much obscurity, chiefly due to the fact that authors have not recognised the essential differences between *Allorisma sulcata* and *Edmondia sulcata*, so well pointed out by King in his Monograph on the Permian Fossils (*op. cit.*, p. 163). Referring to this point (see above, p. 319) in my remarks on *Edmondia sulcata*, I pointed out how completely the two species differ from each other in every detail, though to the casual observer they may seem to be very similar. The hinge-plates are essentially different; *Allorisma sulcata* not possessing the ossicle present beneath the umbo in all species of *Edmondia*, and showing as a slit in casts of the interior. *A. sulcata* has a well-marked lunule, and a specially well-developed escutcheon, both of which are absent in *E. sulcata*. In *A. sulcata* the umbones are not well marked off from the anterior part of the valve, because of the obliteration of the antero-superior angle of the shell, and the depressed lunule; moreover the anterior border seems to pass up into the umbo without any break, but this is not the case in *E. sulcata*. In *A. sulcata* the grooves and sulci are simple and unbroken, passing from before backwards without a break. In *E. sulcata* the ridges are more numerous in front, two coalescing to form a thicker ridge posteriorly and often compound. Further, *A. sulcata* has a well-marked compression from the umbo downwards to the lower border, which is markedly sinuous at this place.

I have given my reasons for supposing that Fleming's *Hiatella sulcata* was founded on specimens of both species (see above, p. 320), and need not repeat them here.

With regard to the pallial sinus, very few specimens indeed are in the proper state of preservation to show the interior, but I think that three specimens in my possession show indications of this character, Pl. XLVIII, figs. 4, 8.

Unfortunately a sinuated pallial line has been intensified in King's type specimen by drawing it in with ink. The specimen is now preserved in the museum at Newcastle-on-Tyne, and I have been unable to obtain permission to borrow the shell for the purpose of figuring it. I have only been able to see the muscle-scars in one example out of the many I have examined, from Redesdale, where this species is one of the commonest fossils in the ironstone beds.

Mr. Neilson has obtained a fine series of specimens (from the excavations in Garngad Road, Glasgow) which have the outer portion of the valve preserved, and show that it was covered with rows of fine tubercles, Pl. XLVIII, fig. 7, agreeing in this character with *Edmondia sulcata.*

Complete examples of *A. sulcata* are rare, the extreme posterior end being often wanting. There is, however, in my opinion, good evidence that this shell gaped slightly behind, but it was certainly close in front and below.

The hinge has not been isolated, but I think it probable that hinge-teeth were either absent or very small, because the valves are often found slightly slipped, the left generally overlapping the right.

ALLORISMA VARIABILIS, *M'Coy*, sp., 1851. Plate XLIV, fig. 2; Plate XLVIII, figs. 1, 2.

SANGUINOLITES VARIABILIS (pars), *M'Coy*, 1851. **Ann. Mag. Nat. Hist., 2nd ser., vol. vii, p. 174.**
— — — *Morris*, 1854. **Cat. Brit. Foss., 2nd edit., p. 223.**
— — — *M'Coy*, 1855. **Brit. Pal. Foss., p. 508, pl. 3 F, figs. 6—8.**
— — — *Young and Armstrong*, 1871. **Trans. Geol. Soc. Glasg., vol. iii, Suppl., p. 54.**
-- — *Armstrong, Young, and Robertson*, 1876. Cat. West. Scott. Foss., p. 55.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 313.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 290.

Specific Characters.—Shell of medium size, transverse, very inequilateral, tumid in front, compressed, and somewhat narrowed from above downwards posteriorly; the whole valve is gently curved from before backwards, the upper border being slightly concave, and the lower margin convex.

The anterior end is short, tumid, separated from the posterior by a well-marked constriction, and much cut away at the expense of its antero-superior angle. Its margin, bluntly rounded, passes downwards and backwards into the inferior border, which is convex, but sinuous in its anterior third, and rises posteriorly more quickly, to pass into the narrowed and rounded posterior margin. The superior border is much shorter than the length of the valve; much depressed in front, but rises gradually towards its posterior end to form an obscure obtuse angle with the posterior border. The umbones are small, incurved, pointed, and contiguous; only slightly raised and moderately tumid; not marked off from the valve in front, but the anterior edge of the shell is continuous with the anterior edge of the umbo, which is placed very far forwards, and much excavated in front by a large, elongate, depressed lunule. The escutcheon is very large and broad, but gradually narrowed and elevated till it vanishes at the posterior margin. It is marked off from the dorsal slope by a raised, angular, curved ridge.

The valve is obliquely convex, with a deep and accentuated sinus, which passes from the umbo to the inferior margin, becoming broader and deeper as it passes downwards. The dorsal slope is compressed, and is concave just below the postero-inferior angle, and crossed by obsolete radiating ribs.

Interior.—The anterior adductor muscle-scar is small and obscure. The posterior is large and shallow, situated below the hinge-line, remote from the posterior end. The pallial line is faint, but deeply sinuate. The inner surface of the valve is marked with irregular concentric grooves and rugæ.

Exterior.—The surface is ornamented with concentric grooves and ridges, which are somewhat irregular in front, *e. g.* a rib may split and unite again. These rugæ are deeply indented by the oblique sinus, and there is an approach to angularity where the rugæ are bent up to pass over the dorsal slope. The ribs are small, much closer, and more irregular towards the lower margin.

The shell was covered with radiating rows of small tubercles, especially over the dorsal slope. Shell very thin.

Dimensions.—Pl. XLVIII, fig. 1, a shell from the Calderwood Limestone, Kilbride, measures—

Antero-posteriorly	70 mm.
Dorso-ventrally	33 mm.
From side to side	25 mm.

Localities.—England: the Limestone of Lowick, Northumberland. Scotland:

the Calderwood Limestone, Kirktonholm, Kilbride; the Limestone of Docra, Beith; Lower Limestone series.

Observations.—M'Coy founded his species of *Sanguinolites variabilis* on two very distinct shells, one of which, from its possession of a sinuated pallial line, does not even belong to that genus. It is difficult to understand why these two shells were confused, as they differ so markedly in shape, contour, and surface markings.

I have found in Mr. Neilson's Collection three other specimens which agree with the more elongate of M'Coy's types. Two of these specimens show the sinuated pallial line of *Allorisma,* to which genus I now refer M'Coy's shell. Thanks to the authorities of the Woodwardian Museum, Cambridge, I have re-figured M'Coy's two types side by side, Pl. XLIV, figs. 1 and 2, to emphasise the differences between them. The rounded posterior end of *A. variabilis* is in marked contrast to the truncate, oblique, almost straight margin of *S. variabilis*. Indeed, it will be noted at once that in every detail the shells are different.

A. variabilis differs from *A. sulcata* in the less regular character of the concentric grooves and ribs. The two species have a somewhat different contour, *A. sulcata* being more regularly oval, less oblique, and not curved on itself from before backwards. *A. variabilis* also attains a much larger size than *A. sulcata.*

ALLORISMA MONENSIS, *sp. nov.* Plate XLVIII, figs. 12—14.

Specific Characters.—Shell of medium size, very inequilateral, obliquely tumid, oblong-ovate. The anterior end is short, deep, and swollen, its margin regularly and bluntly curved. The inferior margin is prolonged, almost straight, or with a shallow sinus about its centre, curving upwards posteriorly to pass with a bluntly rounded curve into the posterior margin. The posterior border is very obtusely but regularly rounded. The hinge-line is slightly arched in front, prolonged and straight behind. The umbones are moderately large, tumid, incurved and pointed, elevated above the hinge-line, and contiguous; situated in the anterior fifth of the valve. Passing downwards and backwards from the umbo to the postero-inferior angle is a blunt oblique tumidity, which marks off the large, elongate, and compressed dorsal slope from the rest of the valve. This oblique gibbosity is more angular in the neighbourhood of the umbones, and gradually becomes flatter as it passes across the valve; the line of its obliquity is not straight, but curved, being concave upwards. In front of this gibbosity the valve is constricted by a well-marked sinus, shallow above, and becoming broader as it approaches the inferior margin. The lunule is of fair size, elongate. The escutcheon is well developed, deep, broad, and long, marked off from the rest of the valve by an angular ridge parallel to the hinge-line.

Interior.—The anterior adductor muscle-scar is large, oval, and shallow; marginal, bounded, as in the genus *Sanguinolites*, by a curved ridge behind. The posterior adductor scar is large, ovate, and shallow, placed close to the hinge-line, but very remote from the posterior end. The pallial line is markedly sinuate, remote from the margin. The hinge-line is edentulous, with a rolled margin posteriorly.

The inner surface was marked by broad, shallow, concentric grooves and rounded ridges, crossed by very obscure, almost obsolete, radiating lines. Immediately below the point where the valves are bent on themselves to form the escutcheon there is to be seen in casts a broad compression parallel to the hinge-line.

Exterior.—The shell is ornamented with many fine concentric striæ and wrinkles, obscurely collected below into grooves and ridges, which become much more apparent in the neighbourhood of the broad sulcus. The dorsal slope is smoother, and crossed by at least one radiating line. Shell very thin.

Dimensions.—Pl. XLVII, fig. 12, measures—

Antero-posteriorly	73 mm.
Dorso-ventrally	38 mm.
From side to side	30 mm.

Localities.—England: the Lower Limestones of Scarlett Point and Balasala, Isle of Man. Ireland: the Carboniferous Limestone of Donaghrisk and Carnteel, co. Tyrone.

Observations.—This species is found in the Lower Limestones of the Isle of Man with *Edmondia sulcata* and *Prolecanites compressus* (Sow.), the *Goniatites Henslowi* of the same author. Judging from the close resemblance between the fauna of the limestone of Kendal Fell, Westmoreland, and that of the Lower Limestones of the Isle of Man, I think it most likely that this species will be found there also. *A. monensis* resembles *A. Ansticei* more closely than any other species of the genus, but its anterior end is comparatively much shorter and deeper, the valves much less gibbose, and the dorsal slope more compressed and less hollow. The surface-markings are also much stronger.

I have referred three very imperfect casts from Donaghrisk, co. Tyrone, to this species. They are preserved in the collection of the Geological Survey in the Science and Art Museum, Dublin; and there is an undoubted specimen from Carnteel, in the same county, in the collection of the Geological Survey at Jermyn Street.

Allorisma Ansticei, *Sowerby*, sp., 1840. Plate XLIX, figs. 1—3.

Unio Ansticei, *Sowerby*, 1840. Trans. Geol. Soc., ser. 2, vol. v, pt. 3; Geol. Coalbrookdale, Appendix, pp. 491 and 501, pl. xxxix, fig. 7.
— ? — *Morris*, 1843. Cat. Brit. Foss., 1st. edit., p. 105.
Sanguinolites contortus, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 48, pl. xix, fig. 3.
Unio Ansticei, *Brown*, 1849. Illust. Foss. Conch., p. 180, pl. lxxxviii, figs. 25, 27.
Myacites Ansticei, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 213.
Sanguinolites contortus, *Morris*, 1854. Ibid., p. 228.
— — *Bigsby*, 1877. Thesaurus Devonico-Carboniferus, p. 311.
Allorisma Ansticei, *Bigsby*, 1877. Ibid., p. 295.
Myacites Ansticei, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 286.
Sanguinolites contortus, *Etheridge*, 1888. Ibid., p. 289.

Specific Characters.—Shell of medium size, transversely oblong, compressed, obliquely tumid, very inequilateral, not carinate. The anterior end short, much narrowed from above downwards by the rapid descent of its upper border, and moderately convex, its margin bluntly rounded. The antero-inferior angle projects forward. The inferior margin is almost straight, with a sinuosity at about its centre, but becoming convex posteriorly, where it is curved bluntly upwards to pass into the posterior margin. The latter is obliquely truncate from above downwards and backwards, and is straight above but rounded obtusely below. The postero-superior angle is well marked and obtuse. The hinge-line is depressed, curved in front, prolonged and straight behind. The umbones are of moderate size, obliquely swollen, incurved, pointed, contiguous, raised above the hinge-line, and placed at the junction of the anterior and middle thirds of the valve. Passing downwards and backwards from the umbones towards the postero-inferior angle is an oblique gibbosity, narrow and well marked above, but becoming broader and less conspicuous as it passes across the valve. An erect curved ridge passes from the extreme point of the umbo backwards, and terminates at the postero-superior angle, separating the escutcheon from the dorsal slope.

In front of the oblique gibbosity the valve is much compressed, giving rise to a well-marked lateral sinus, which is narrow above but becomes broader and deeper as it approaches the inferior margin. The oblique gibbosity passes gradually into the dorsal slope, which is of moderate size, compressed, and hollowed. The lunule is large, deep, and elongate. The escutcheon is broad, shallow, and elongate.

Interior.—The anterior adductor scar is oval, shallow, and marginal; the posterior scar is large and oval, and placed immediately within the postero-superior angle. The pallial line is entire, probably sinuated. The hinge-plate leaves in casts no indications of hinge-teeth. The inner surface of the valve is covered with concentric grooves and sulci, crossed by numerous fine, almost obsolete, radiating lines.

Exterior.—The surface is ornamented with fine concentric striæ of growth, best seen in front and along the inferior margin; but these become obsolete over the umbones and dorsal slope. The dorsal slope is crossed by two radiating lines, which pass from the umbo to the posterior border. The striæ are often divided into groups by obsolete concentric grooves. Over the anterior third of the valve the surface is finely tuberculated; the minute raised points are arranged in radiating rows. Shell thin.

Dimensions.—Pl. XLIX, fig. 3, a specimen in my collection, from the Pennystone Ironstone of Coalbrookdale (the bed where the type was obtained), measures—

Antero-posteriorly	70 mm.
Dorso-ventrally	34 mm.
From side to side	30 mm.

Localities.—England: the Pennystone Ironstone, Coalbrookdale, Shropshire. Scotland: the Lower Limestone series of Auchenmade, Ayrshire. Ireland: Chicken Hill, Kilmallock, co. Limerick.

Observations.—This species was originally described by J. de C. Sowerby as *Unio Ansticei*, in the appendix to Prestwich's 'Memoir,' p. 501, but his short descriptive note is meagre and contradictory. The type specimen, Pl. XLIX, fig. 2, is preserved in the British Museum (Natural History), South Kensington. I do not know of any other specimens from the locality of Coalbrookdale, except the one in my possession. Both are in the form of casts, and my specimen, Pl. XLIX, fig. 3, shows the details of the interior very well.

I have little or no hesitation in referring the *Sanguinolites contortus* of M'Coy to Sowerby's species. M'Coy's description agrees in every detail with the characters exhibited by the Coalbrookdale specimens. He says, "This species is wider than the *Unio Ansticei*, and more nearly resembles the common *S. tumida;*" but he does not enumerate any other distinctive characters between his specimen and *U. Ansticei.* He gives two inches four lines as the width and length of *Sanguinolites contortus;* Sowerby gives two and a half inches as the width (length) of *Unio Ansticei;* so that this statement is unwarranted. It must be noted that Phillips gave Coalbrookdale as one of the localities for his *Sanguinolites ? tumida*, but there is very great doubt indeed as to the real nature of the shell he referred to under this title. Still there is no other species occurring in Coalbrookdale to which he could with any propriety have referred by this name.

Pl. XLIX, fig. 1, is a beautifully preserved specimen in the collection of Mr. J. Smith, of Kilwinning, showing the tuberculated markings on the anterior part of the valve. Whether such markings occurred all over the valve or not I am unable to decide, owing to the great paucity of specimens.

All prior observers have considered that *Allorisma Ansticei* gaped. It certainly did not gape in front; and I am very doubtful if it gaped behind. The shell was very thin, especially behind, and has been broken off here in all the specimens I have been able to examine. The marked and characteristic byssal sulcus and the absence of a byssal notch are noteworthy. *Tellinomorpha* (*Chænomya*) *jucunda* of de Koninck has certain points of resemblance with *A. Ansticei;* but it is much more gibbose, and has the byssal sulcus much less marked. Notwithstanding the fact that the distribution of this species is wide, I regard it as very rare.

Genus—TELLINOMORPHA, *de Koninck*, 1885.

CHÆNOMYA (pars), *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 4.
TELLINOMORPHA, *de Koninck*, 1885. Ibid., p. 90.

Generic Characters.—Shell equivalve, inequilateral, transverse, ovate. Anterior side rounded, closed; posterior side truncate, gaping. Hinge of the right valve having a single cardinal tooth, with a socket on either side, in at least one species. Pallial line entire; escutcheon deep and broad, and much shorter than the posterior part of the valve. Surface with irregular concentric undulations and striæ of growth, crossed by rows of small granules or tubercles. Shell thin.

Observations.—The genus *Chænomya* was established by Meek and Hayden (1864) for certain shells from the coal-measures of North America, and was supposed by them to embrace also certain Jurassic shells referred to *Myacites.* The shells are said to be edentulous, but no figures of the hinge are given. The posterior end is described as gaping, and a large but shallow pallial sinus is noted and figured. In addition the authors state that all the species yet known are also destitute of any traces of a shallow depression extending from the beaks to the antero-ventral margin, so commonly seen in *Myacites.*

Under these circumstances de Koninck was ill-advised to refer any of the Belgian Carboniferous shells to *Chænomya;* for three at least, and possibly all (four) species referred by him to that genus possess a well-marked sinus in the neighbourhood of the junction of the anterior and middle thirds of the valve; all have an entire pallial line, and one species, *Chænomya jucunda*, has not an edentulous hinge; for he says, " J'ai en outre pu observer dans l'impression de la charnière de la *C. jucunda*, une petite fossette produite par la présence d'une dent très peu développée et difficile à constater."

Certain species included under *Chænomya* by de Koninck belong to a group of *Sanguinolites*, of which *S. argutus* may be considered as a type,—for example, *S. Walciodorensis*. I am of opinion that the *Chænomya jucunda* of de Koninck really belongs to that author's genus *Tellinomorpha*, with which it agrees in every important character; and, on de Koninck's own showing, possesses the hinge which he considers as characteristic of that genus.

Tellinomorpha was erected as a genus by de Koninck to receive a single valve from the Upper Carboniferous beds of Belgium, but the exact locality is not stated in the text. Fortunately the hinge was exposed in this example, a right valve; and I am glad to be able to record the occurrence of the same species (*T. cuneiformis*) in the uppermost beds of the mass of limestone at Castleton, Derbyshire, and Hill Bolton, Yorkshire.

British shells show that the genus had the surface of the valve covered by radiating rows of small tubercles, a character, however, possessed by other Carboniferous genera, notably *Edmondia*, *Sanguinolites*, and *Allorisma*. From the first of these *Tellinomorpha* differs so essentially that it is unnecessary to discuss the matter; but it has a very close affinity to *Sanguinolites*, from which it differs in the possession of a denticulate hinge, and the absence of any approach to an oblique ridge, even in the umbonal region. The escutcheon, too, differs in being deeper and more concave in section, and not extending so far backwards as it does in *Sanguinolites*, and not having the erect dorsal margin of that genus. *Tellinomorpha* is not so transverse, has not the simple ribs and sulci, or the long escutcheon of *Allorisma*.

The name *Tellinomorpha* is a very unfortunate one, for the shells in question have no affinity whatever with *Tellina* either in the general character of the valve or in the structure of the hinge. It is impossible to conceive on what ground de Koninck makes the following statement:—" C'est la première espèce carbonifère qu'avec une forte présomption d'exactitude on peut introduire dans la famille des Tellinidæ; la structure de la charnière et la forme générale de la valve sont très semblables à celles de certaines espèces vivantes appartenant à cette famille." The name is quite as unfortunate, indeed, as *Tellinomya*, which has the multidenticulate hinge of the *Nuculidæ*.

Tellinomorpha more closely resembles several Jurassic genera of Lamellibranchs originally included under the *Myacites* of Schlotheim, but this fact has been discussed above, p. 419.

TELLINOMORPHA JUCUNDA, *de Koninck*, sp., 1885. Plate XLIX, fig. 4.

CHÆNOMYA JUCUNDA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 7, pl. i, figs. 1—8; pl. xiii, figs. 38, 39.

Specific Characters.—Shell above the medium size, transversely ovate, tumid, gaping posteriorly, without a keel, very inequilateral. The anterior end is short, blunt, turgid, depressed; its margin bluntly rounded, but salient. The inferior border is almost straight, and may be concave about the junction of the anterior and middle thirds of its extent; it becomes more convex behind. The posterior end is truncate above, but bluntly rounded below, its superior and inferior angles being almost obsolete; the posterior border is about as long as any dorso-ventral diameter of the valve.

The hinge-line is arched in front, but almost straight behind, much shorter than the shell, and depressed. The umbones are small, depressed, incurved, and not contiguous, placed in the anterior third of the valve. The lunule is small and shallow; the escutcheon long and shallow, but very broad, bounded externally by an erect, low, bluntly angular ridge, which passes backwards from the umbo to the posterior border, and internally by the erect hinge-line.

The valves are regularly convex from above downwards, but the antero-posterior curvature is interrupted by a broad, well-marked shallow sinus, which extends from the umbo to the inferior margin, at the junction of the anterior and middle thirds of the valve. The dorsal slope is only slightly compressed.

Interior.—The anterior adductor muscle-scar is almost obsolete, with no ridge behind it; the posterior scar is normal in position; the pallial line entire. The hinge-plate is much thickened below the umbones, but the actual hinge has not been isolated.

Exterior.—The surface is ornamented with irregular folds and wrinkles, concentrically arranged, and fine striæ and lines of growth. There is obscure evidence that the surface was covered with radiating rows of granules or tubercles. Shell thin.

Dimensions.—Owing to the fact that I have not been able to examine any perfect British examples of this species, I give the dimensions of a Belgian specimen from the Carboniferous Limestone of Tournai, which measures—

Antero-posteriorly	87 mm.
Dorso-ventrally	48 mm.
From side to side	41 mm.

Localities.—England: the Carboniferous Limestone of Park Hill, Derbyshire. Ireland: Rathkeale, co. Limerick.

Observations.—This species was described by de Koninck under the generic term *Chænomya.* I have shown in my observations on the genus *Tellinomorpha* that the shells which he included under the genus *Chænomya* possess a set of characters totally different from those which the authors of the genus assign to it. De Koninck gives ten figures of the species (*op. cit.*), mostly of casts, and he states that a single testiferous example only has been found.

It cannot be said that the British specimens are at all satisfactory, but Pl. XLIX, fig. 4, in the collection of the Geological Survey, Jermyn Street, is a testiferous example, though only the anterior three-fourths of the shell is preserved. The Irish specimens are also very incomplete.

T. jucunda bears some relation to *Allorisma Ansticei*, Sow., sp., but the latter species is comparatively much more transverse, and has a deeper oblique sinus, and never attains to such dimensions as *T. jucunda.*

TELLINOMORPHA CUNEIFORMIS, *de Koninck*, 1885. Plate XLIX, figs. 5—9.

TELLINOMORPHA CUNEIFORMIS, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 91, pl. xxi, figs. 1, 2.

Specific Characters.—Shell of medium size, transverse-ovate, inequilateral, compressed. The anterior end is short, moderately tumid, with a rounded border, passing with regular curve into the inferior margin, which is very feebly convex, and may even be sinuous in the middle third, but becomes strongly curved posteriorly where it passes without a break into the well-rounded posterior border. This is only slightly deeper from above downwards than the anterior; there are no postero-superior or postero-inferior angles.

The hinge-line is arched, the posterior portion being gradually depressed. The umbones are small, incurved, contiguous, and swollen; very little raised above the hinge-line, and placed in the anterior third of the valve. The lunule is narrow and elongate. The escutcheon, broad and shallow, is bounded anteriorly by a low ridge, which passes from the umbo to the posterior border. The inner edge of the valve, at about one-third of its distance from the posterior end, is bent gently outwards, so that opposing edges of the valve are not in contact. The valve is curved on itself from above downwards and convex; but from before backwards the valve is on the whole compressed, commencing in front with a fair amount of convexity; the middle third of the valve is markedly compressed by a broad shallow groove, which commences above at the umbo, and becomes broader as it approaches the lower margin. The posterior third of the valve is more regularly convex, there being only a very slight amount of flattening along the dorsal slope.

Interior.—The adductor muscle-scars are obscure. Pallial line not observed. Hinge-plate thickened, leaving a broad groove in casts.

Exterior.—The surface is covered with irregular concentric folds and wrinkles, made up of bundles of striæ and lines of growth; the whole crossed by numerous low tubercles arranged in radiating rows, often only visible under the microscope. They occur even in the hollow of the escutcheon; but in the anterior portion of the shell the tubercles may become confluent. Shell thin.

Dimensions.—As all the full-grown examples I have are imperfect, I give the dimensions of a very young example, Pl. XLIX, fig. 5.

Antero-posteriorly	31 mm.
Dorso-ventrally	18 mm.
From side to side	15 mm.

Pl. XLIX, fig. 7, a large valve, measures—

Antero-posteriorly (estimated)	64 mm.
Dorso-ventrally	30 mm.

Localities.—England: the Carboniferous Limestone of Park Hill, Thorpe Cloud, and Castleton, Derbyshire; Hill Bolton, Yorkshire; and the Poolvash Limestone, Isle of Man. Scotland: the Upper Limestone series at Garngad Road, Glasgow, and Thornton; the Lower Limestone series of Hind og glen, Dalry, and Auchenskeith, Ayrshire.

Observations.—The genus *Tellinomorpha* was founded by de Koninck to receive a single valve of this species (see page 431), which occurred in the Upper Carboniferous Limestone of Belgium. I have been fortunate enough to collect many specimens from the British localities mentioned above, several of which have the very beautifully marked characteristic test preserved; but few of the specimens are complete, and casts of the interior, which I have yet obtained, unfortunately exhibit no details of the muscle-scars, pallial line, or hinge. Mr. Smith has obtained two very perfect examples from Scotland. De Koninck did not recognise the peculiar character of the surface, but was able to describe and figure the hinge-plate. With his original description I am not able entirely to agree; for his specimen being very deficient at the posterior end, the shape is hardly cuneiform; nor, if he had noticed the actual contour of the earlier lines of growth, could he have said that the posterior end was truncate, or, looking at the figure, that the hinge-line was straight.

A comparison of de Koninck's type specimen, preserved in the Musée Royal d'Histoire Naturelle, at Brussels, and the figure shows that the dotted contour for the posterior and lower part of the valve is very incorrect; for, if the true curvature of the borders be taken, the posterior end is shown to have been much broader than the drawing would indicate.

Tellinomorpha cuneiformis is much more transverse and less gibbose than *T. jucunda*.

It would appear, from the conformation of the posterior part of the hinge-line, that the valves were not in contact posteriorly, and that the shell gaped widely in this position. Pl. XLIX, fig. 5, seems to show this conclusively; but there is strong evidence that the valves were closed in front.

Two very perfect specimens have been obtained by Mr. John Smith of Kilwinning from the Lower Limestone series of Scotland. One, Pl. XLIX, fig. 5, has the outer tuberculate layer of the shell wanting, but it is not crushed, and shows the peculiar escutcheon and the gaping posterior end very perfectly. The other, Pl. XLIX, fig. 6, is somewhat crushed, so that, seen from above, its special characters have been obliterated, and it appears to have no escutcheon; but, on the other hand, the condition of the valves is so well preserved that the rows of radiating tubercles are easily seen, even by the naked eye.

Family—SOLENOMYIDÆ, *J. E. Gray*.

Genus—Solenomya[1] [Solemya], *Lamarck*, 1819.

Solemya, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 209.
— *de Koninck*, 1842. Anim. Foss. Terr. Carb. Belg., p. 59.
— *Portlock*, 1843. Geol. Rep. Londonderry, p. 441.
— *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 101.
Sanguinolites (pars), *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 50.
Solemya, *de Verneuil*, 1845. Géol. Russie, vol. ii, p. 294.
Janeia, *King*, 1849. Permian Fossils England, p. 177.
Solemya, *d'Orbigny*, 1850. Prodrome paléontol., vol. i, p. 129.
— (pars), *de Ryckholt*, 1853. Mél. paléontol., 2e partie, p. 49.
— *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 224.
Solenimya, *M'Coy*, 1855. Brit. Pal. Fossils, p. 518.
— *Cox*, 1857. Geol. Surv. Kentucky, vol. iii, p. 573.
— *Shumard and Swallow*, 1858. Trans. St. Louis Acad. Sci., vol. i, p. 208.
Solenomya, *Eichwald*, 1860. Lethæa Rossica, p. 1040.
— *Meek and Worthen*, 1866. Geol. Surv. Illinois, vol. ii, p. 349.
Solenimya, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 54.

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[1] This is Blainville's form of the word (1825).

SOLENOMYA (?), *Meek*, 1875. Ohio Pal., vol. ii, p. 339.
— *Armstrong, Young, and Robertson*, 1876. Cat. West. Scott. Fossils, p. 55.
SOLEMYA, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 313.
— *Baily*, 1880. Mem. Geol. Surv. Ireland, Expl. of Sheets 42 and 54, p. 22.
— *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belge, vol. xi, p. 119.
— *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 291.
JANEIA, *Beushausen*, 1895. Abh. König. Preuss. Geol. Landesanstalt, n. F., Heft 17, p. 290.
— *Wolterstorff*, 1899. Untercarbon Magdeburg-Neustadt und seine Fauna, p. 99.

Generic Characters.—Shell elongated, very inequilateral, anterior end much longer than the posterior, both ends gaping. Surface marked by obscure concentric lines and well-marked ribs, radiating forwards from the umbones. Anterior adductor muscle-scar elongate and pear-shaped, shallow; the posterior scar round and deeper. Shell thin, periostracum well developed and overlapping the margins.

Observations.—King proposed to give the name *Janeia* to the Palæozoic forms of *Solenomya*, but gave no reasons for his suggestion, and the name has been completely in abeyance until Beushausen emended the description in 1895. This author discusses at length (*op. cit.*) the reasons which have induced him to consider that the Palæozoic and recent forms of *Solenomya* should be separated into two genera. He states that the Palæozoic forms are inequivalve, and that the right valve is always overlapped by the left, and that the shell may or may not gape at either end.

It cannot be denied that a large number of specimens of *Solenomya primæva* have the left valve overlapping the umbo of the right; and de Verneuil has drawn attention to the same fact (*op. cit.*). M'Coy states, "In all our numerous specimens the left valve is larger at the beak than the right one;" but he says nothing about the overlapping.

My own opinion is that the overlapping of the valves is an accident, largely due to the fact that the shells were edentulous. Many specimens of *Edmondia oblonga*, *E. rudis*, *E. unioniformis*, and other species show the same slipping of the valves, and here there is no question of the valves being unequal. I have, too, a specimen of *Solenomya excisa* from Tournai, where the right valve has slipped over the left. Now, granting that the valves have slipped on each other, such a condition would obliterate the gaping of the ends of the shell by bringing the anterior and posterior edges respectively into contact with each other, so that it is very probable that both the characters on which Beushausen relies to distinguish the Palæozoic from the recent *Solenomyæ* are due to the same accidental cause.

The amount of overlapping, in the series of British specimens which I have been able to examine, is very variable, being absent in some and very marked in others. The absence of gaping behind may be due to the fact that there is a slight amount of dislocation of the valves posteriorly. M'Coy's type has been considerably improved upon in the original drawing. The overlapping itself in this specimen is of the slightest amount, and the shell appears to gape only in front; and further, Beushausen's figures (pl. xxvi, figs. 1 *c*, 2 *c*, 4 *c*) do not show any overlapping of the valves, and only the smallest degree of inequality in the valve.

Beushausen admits that living and Palæozoic forms have a certain remote (*weitgehende*) resemblance in shape, sculpture, position of ligaments, and muscle-scars. But he considers that there is some little difference in the character of the posterior end of the ligament. With regard to the question of the gaping of the shell, he thinks that *S. primæva* gapes in front only, and *S. biarmica* at both ends. It seems to me, therefore, that the separation of *Janeia* and *Solenomya* is based on problematical characters only, while all the important points of resemblance are considered of no value. I am therefore unable to follow Herr Beushausen, and see no reason for accepting his emended genus *Janeia*.

Beushausen thinks *Clinopistha* (Meek and Worthen) to be unnecessary. But here again I am unable to agree with him. The shells referred to *Clinopistha* by Meek and Worthen, and by de Koninck, differ so markedly in shape, sculpture, and general character from *Solenomya* that the retention of the genus is very useful. Beushausen says that intermediate forms exist, as shown by his specimens. This is probable, but none of the specimens figured by him have the contour of the type of *Clinopistha;* the only one approaching it, *J. truncata* (pl. xxvi, figs. 4 *a*—*c*), being too transverse. *Clinopistha* certainly was closed all round.

Beushausen seeks to strengthen his case by stating that some specimens of *Allorisma* gape and others do not. I do not think that any species of *Allorisma* gape, and that the appearance of gaping in some specimens is merely due to the fact that the shell was filled with mud, and was fossilised with the valves somewhat open, though still connected along the hinge-line; a condition which must have happened when dead shells were filled.

I recognise three species of *Solenomya* in British Carboniferous rocks; two of which are also found in the limestone of Belgium, and one I am unable to distinguish from a North-American form, *S. radiata*, Meek and Worthen. Two Belgian forms (*S. saginata, S. parallela*) I am not able to find in England.

Edmondia arcuata, Phillips, sp., was referred to *Solenomya* by de Ryckholt (*op. cit.*). One can well understand that he did so. As I have pointed out above, p. 311, this species has the anterior adductor muscle-scar in a different position from the rest of the species of the genus, and if the long end of this shell was supposed to be anterior, the arrangement of the muscle-scars would have a very close resemblance to that which obtains in *Solenomya*. Of course the well-marked umbones, the internal ossicle, and other characters of *E. arcuata* sufficiently clearly mark off the shell from *Solenomya* (compare Pl. XXXV, figs. 2—4, 6, and 7).

Many of the characters of *Solenomya* would lead one to suppose that the larger end, as in nearly all Lamellibranchs, was posterior. The shape and nature of the muscle-scar in the short end is identical with the anterior muscle-scar of many Carboniferous genera of Lamellibranchs, and it is bounded on its edge remote from the margin of the valve by a ridge, which leaves a groove in casts. Further, the muscle-scar of the long end of *Solenomya* has the characters of the posterior adductor, *i.e.* it is shallow, pear-shaped, placed obliquely, and remote from the margin. As a rule the umbones are directed forwards in *Solenomya*, and in Carboniferous forms they seem to point backwards. Again, in Lamellibranchs the radiating ribs or striæ, when present, slope, as a rule, downwards and backwards. In fact, there is nothing in the shell of the Palæozoic *Solenomya* to denote that the short end is posterior, but judging from homology, rather the contrary. In recent *Solenomyæ* of course the position of the siphons determines the posterior end of the shell, unless it be the position of the siphons which have changed, and not the shell. I have never yet been able to find the shell with the periostracum preserved, or to obtain any indication that the lower edges of the shell were not in contact, or that there was any great development of periostracum with fringes which overlapped them.

Solenomya primæva, *Phillips*, 1836. Pl. L, figs. 1—6.

Solemya primæva, *Phillips*, 1836. Geol. Yorks., pt. 2, pp. 209 and 247, pl. v, fig. 6.
— — *Portlock*, 1843. Geol. Rep. Londonderry, p. 441.
— — *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 101.
— Puzosiana, *de Koninck*, 1843. Anim. Foss. Carb. Belge, p. 60, pl. v, figs. 2 *a*, *b*.
Sanguinolites radiatus, *M'Coy*, 1844. Synop. Carb. Foss. Ireland, p. 50, pl. xiii, fig. 94.
Non Solemya primæva, *de Verneuil*, 1845. Géol. Russie, vol. ii, p. 295, pl. xix, fig. 5,
— — *d'Orbigny*, 1850. Prodrome paléontol., vol. i, p. 129.
— Puzosiana, *d'Orbigny*, 1850. Ibid., p. 129.
— primæva, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 224.
Non Solenimya? primæva, *M'Coy*, 1855. Brit. Pal. Foss., p. 519, pl. iii, figs. 3, 3 *a*.
— — *Eichwald*, 1860. Lethæa Rossica, p. 1040, pl. xxxix, fig. 10.

Antero-posteriorly	77 mm.
Dorso-ventrally	26 ,,
From side to side (estimated)	15 ,,

Localities.—England: the Carboniferous Limestone series of Lowick, Northumberland; Carboniferous Limestone, Derbyshire (specimens in the Woodwardian Museum); Halkyn Mountain, North Wales; Middleton, near Wirksworth. Scotland: the Upper Limestone series of Thornliebank and Bathgate; Lower Limestone series of Hairmyres and Ardross; Calciferous Sandstone series, Encrinite bed, east of Pittenweem, Fife. Ireland: Desertmartin, co. Derry; Aghaloo, co. Tyrone.

Observations.—Phillips erected the species *Solemya primæva* upon certain shells from Northumberland, stated to be in his own collection, and in the Yorkshire Philosophical Society, and the Natural History Society of Newcastle-on-Tyne. The type specimen seems to have been in his own collection, and is lost.[1] There is very little doubt, however, owing to the preservation of the unfigured shells in the public collections to which he refers, as to the identity of the species, of which the description, though meagre, and the figure, though poor, are also sufficiently definite to enable the species to be preserved. In 1843 Portlock redescribed the species (*op. cit.*), quoting Phillips's diagnosis; and his type, though unfortunately not figured, is preserved in the Museum of the Geological Survey, Jermyn Street, and I am permitted by the kindness of Sir A. Geikie to re-figure the specimen, a very fine and well-grown example, Pl. L, fig. 2. In the same year de Koninck described the same species under the name *S. Puzosiana.* At that time he did not discuss its affinities; but in his second great work (in 1885, *loc. cit.*) he says "Cette belle espèce, que j'ai cru devoir dédier à Puzos, . . . se distingue facilement des *S. primæva*, J. Phillips, et *sagenaria*, P. de Ryckholt, par sa grande taille, par sa forme relativement plus allongée, et par le parallélisme de ses bords cardinal et ventral." The average measurements given by de Koninck are—"length 55 mm., height 24 mm., thickness 12 mm."

It would be thus apparent that Portlock's shell is much larger even than de Koninck's, and that the comparative dimensions are practically identical in both cases. Judging from the dimensions of Phillips's figure, one cannot quite understand de Koninck's "attitude," for the figure measures antero-posteriorly 37·5 mm., dorso-ventrally 15 mm., or as 5 : 2. This multiplied by 11 gives 55 : 22, showing comparative measurements not very far from those of de Koninck's species, and is in contradiction to his statement that *S. Puzosiana* is relatively more elongate than *S. primæva*.

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[1] See page 19, foot-note.

Solenomya primæva can be readily distinguished from the other fossil species of the genus even in casts by the presence of broad flattened ribs, radiating forwards from the umbo. *S. costellata* is quite smooth in casts, although it has somewhat the same shape as *S. primæva*. *S. excisa* differs so markedly from both the other species in the possession of a well-marked narrowing of the posterior extremity, that it is unnecessary to say more on the subject of differential diagnosis.

SOLENOMYA EXCISA, *de Koninck*, 1885. Plate L, figs. 11, 12, 14—16.

SOLEMYA ARCUATA, *de Ryckholt*, 1853. Mélanges paléontol., pt. 2, p. 52.
— SYMESII, *Baily*, 1880. Mem. Geol. Surv. Ireland, Expl. Sheets 42 and 54, p. 22, two figures only.
— EXCISA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 122, pl. xxiii, figs. 30, 39, 40, 42, 43; and pl. ix, figs. 13, 14.

Specific Characters.—Shell inequilateral, obovate, lanceolate; gibbose above, compressed below. The anterior end is by far the larger, and is much deeper from above downwards than any other part of the shell, and moderately tumid; its border is bluntly rounded, but with a tendency to angulation at the junction of the upper and anterior margins. The superior margin is produced, and very gently convex. The posterior border is narrowed by the descent of the upper margin, truncate. The upper margin is elevated and arched in front, but descends rapidly posterior to the umbones, the postero-superior angle being well marked. The umbones are small, tumid, elongate, contiguous, not raised, and placed at the junction of the middle and posterior thirds of the valve; excavated posteriorly by a broad hollow escutcheon, which is separated from the rest of the valve by an obscure curved ridge. The posterior end of the valve is short and compressed, beaked, much more swollen above than below.

Interior.—The anterior adductor muscle-scar is shallow and pear-shaped, remote from the anterior edge; the posterior scar is round and deep, bounded in front by a low curved ridge. Pallial line entire. The inner surface of the shell was marked by irregular concentric grooves and obsolete folds, crossed by numerous very fine radiating striæ, passing for the most part downwards and forwards.

Dimensions.—Pl. L, fig. 11, measures—

Antero-posteriorly	50 mm.
Dorso-ventrally	22 mm.
From side to side	15 mm.

Localities.—England: the Carboniferous Limestone series of Lowick, Northumberland. Scotland: the Carboniferous Limestone series of Ardross. Ireland: the Lower Limestone series, half a mile north of Easky, Bunowna, co. Sligo.

Observations.—Unfortunately Baily gave no description with the figure of his species *S. Symesii*, and the figured specimen has been lost for several years, so that the name cannot be retained, and I have to adopt *S. excisa*, de Koninck.

The less transverse shape, the absence of radiating ribs, and the much depressed, almost beaked posterior end distinguish this shell from all other Carboniferous species of the genus. It is to be noted, however, that the narrowing of the posterior end is much more conspicuous in casts.

It may be remarked that the specimen figured by de Koninck (*loc. cit.*, pl. ix, fig. 14) shows the shell to be equivalved, and that it does not gape. Beushausen calls attention to the fact that this specimen does not show the slit for the ligament posteriorly; but I would suggest that the boss shown in fig. 14 represents the structure, ligamentous or not, which occupied the slit.

SOLENOMYA COSTELLATA, *M'Coy*, sp., 1844. Plate L, figs. 7—10, 13.

SANGUINOLITES COSTELLATUS, *M'Coy*, 1844. Synop. Carb. Foss. Ireland, p. 48, pl. viii, fig. 5.
SOLEMYA PRIMÆVA, *de Verneuil*, 1845. Géol. Russie, vol. ii, p. 295, pl. xix, fig. 5.
SANGUINOLITES COSTELLATUS, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 223.
SOLENIMYA (PRIMÆVA), *M'Coy*, 1855. Brit. Pal. Foss., p. 519, pl. iii F, figs. 3, 3 *a*.
SOLENOMYA RADIATA, *Meek and Worthen*, 1860. Proc. Acad. Nat. Sci. Philadelphia, p. 457.
— — — 1866. Geol. Surv. Illinois, Palæont., vol. ii, p. 349, pl. xxvi, figs. 10 *a*, *b*.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 312.
SANGUINOLITES COSTELLATUS, *Bigsby*, 1878. Ibid., p. 311.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 289.

Specific Characters.—Transverse, oblong, upper and lower margins almost parallel, very inequilateral, compressed. The anterior end is much the longer, gradually compressed, gaping, its border somewhat truncate, bluntly rounded below into the lower margin, but above forming a rounded angle with the hinge-line. The longest dorso-ventral diameter of the valve is almost at the anterior end. The inferior border is elongate and almost straight, but near the posterior end becomes more convex. The posterior end is narrowed by the approach of the upper and lower margins (the upper margin descending very rapidly), elliptical, with a bluntly rounded margin. The posterior border is arched, rapidly depressed posterior to the umbones, and very nearly as long as the shell. The umbones are small, compressed, elongate, not elevated, excavated behind by the escutcheon, and placed in the posterior third of the valve. The valves are much more convex from above downwards than from before backwards, and there is a well-marked broad, shallow compression about the middle of the valve, which shows as a slight sinuosity in the ventral border. The greatest gibbosity of the valves is subumbonal and just below the dorsal border, the shells becoming gradually compressed between this line and the ventral margin.

Interior.—The anterior adductor muscle-scar is large and pear-shaped, remote from the margin; the posterior scar is deep, ovate, bounded in front by a well-marked ridge. Pallial line entire. In casts, above the anterior adductor scar, between it and the hinge edge, is a groove which corresponds with a thickening of the edge of the valve. The internal surface of the shell was almost smooth, with very irregular, almost obsolete, concentric grooves and very fine obsolete radiating lines, most marked in the anterior part of the valve.

Exterior.—The surface is glossy; concentric markings are almost entirely obsolete, but the shell is crossed by many flat radiating ribs, fairly close together in front, and becoming more widely separated as they pass towards the middle of the valve, but closer again towards the posterior end. These ribs have rather prominent edges, often with a shallow linear groove between the narrower ones towards the posterior end; but in the broader anterior ribs the linear groove is replaced by a somewhat hollowed surface. Shell thin over the anterior two thirds, rather thick at the posterior end.

Dimensions.—The specimen in the Woodwardian Museum, figured as *S. primæva* by M'Coy, measures—

Antero-posteriorly	45 mm.
Dorso-ventrally	16 mm.
From side to side	13 mm.

Localities.—England: the Carboniferous Limestone series of Lowick and the Fourlaws Limestone at the Coomb, near Redesdale, Northumberland. Ireland: Killycloghy, Lisbellaw, co. Tyrone.

Observations.—The type of *Sanguinolites costellatus*, M'Coy, consisting of a fragment of a cast of the posterior end of the left valve, is preserved in the Griffith collection in the Museum of Science and Art, Dublin. It is a poor example, but shows faint indications of the radiating ribs. M'Coy's description is as follows: "transversely oblong, depressed, anterior side short, rounded, marked towards the margin with four or five short, flat, radiating ribs."

S. radiata was established by Meek and Worthen for a shell from the Coal-measures of Illinois, U.S.A., and I have no hesitation in referring the American species to *S. costellata*. The two species agree perfectly both in diagnosis and figure, with the exception that the antero-inferior angle of the figured specimen seems to be more cut away than in any other specimen that I have seen. This may possibly be due to the imperfection in the original specimen. The characteristic radiating ribs are different from those possessed by *S. primæva*, both in character, grouping, and distribution.

The shells described and figured both by de Verneuil and M'Coy (*op. cit.*) under the name *S. primæva* are without doubt examples of *S. costellata*. M'Coy's description is very careful and accurate, the characteristic ribs being described at considerable length. I am able to reproduce the specimen that he figured (Pl. L, fig. 13), which is that of an almost perfect cast, by the kindness of Prof. McKenny Hughes, of Cambridge. M'Coy did not give a figure of the exterior; and, indeed, it is very rare to meet with examples having the test preserved, owing to its fragility. M'Coy's figures are largely hypothetical, especially the view of the hinge-line and umbones.

All specimens of this shell that I have yet seen have the valves displaced, the left valve overlapping the right. De Verneuil and M'Coy both noted this fact, and thought it to be a structural character. I feel convinced, however, that the displacement is due to the absence of hinge-teeth to keep the valves in line after they had been buried; but doubtless there is some structural reason why the left always overrides the right valve. It is to be noted that the displacement in M'Coy's specimen is practically *nil*, and that it gapes slightly at the anterior, but not at the posterior, end; but the absence of gaping in this position is possibly due to the slight displacement of the valves at this portion of the shell.

Genus CLINOPISTHA, *Meek and Worthen*, 1870.

SOLEMYA (pars), *de Ryckholt*, 1853. Mélanges paléontol., pt. 2, p. 53.
EDMONDIA (pars), *Hall*, 1858. Geol. Rep. Iowa, vol. i, pt. 2, p. 716, pl. xxix, fig. 3.
CLINOPISTHA, *Meek and Worthen*, 1870. Proc. Acad. Nat. Sci. Philadelphia, p. 43.
— *Meek*, 1871. Proc. Acad. Nat. Sci. Philadelphia, p. 67.
TELLINOMYA (pars), *Hall and Whitfield*, 1872. Twenty-fourth Ann. Report N. York Mus. Nat. Hist., p. 192.
CLINOPISTHA, *Meek and Worthen*, 1873. Geol. Surv. Illinois, Pal., vol. v, p. 584, pl. xxvii, fig. 7.
DYSTACTELLA, *Hall*, 1883. Pal. New York, vol. v, pt. 1, p. 513.
CLINOPISTHA, *White*, 1884. Report Geol. Surv. Indiana, 1883, p. 147, pl. xxxi, figs. 6, 7.

Dystactella, *Walcott*, 1885. Monogr. U.S. Geol. Surv., vol. viii, p. 172.
Clinopistha, *Hall*, 1885. Pal. New York, vol. v, pt. 1, Lamellib., pt. 2, p. liv.
— *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 123.
— *Fischer*, 1887. Manuel de Conchyliologie, p. 1157.
— *Keyes*, 1888. Proc. Acad. Nat. Sci. Philadelphia, p. 233.
— *Miller*, 1889. North American Geol. and Palæontol., p. 472.
— *Meek and Worthen*, 1890. Geol. Surv. Illinois, Pal., vol. viii, p. 122, pl. xix, fig. 3; and pl. xxi, fig. 2.
— *Keyes*, 1894. Missouri Geol. Surv., vol. v, Pal., pt. 2, p. 124, pl. xlvi, figs. 11 *a*, *b*.
Janeia (pars), *Beushausen*, 1895. Abh. König. Preuss. Geol. Landesanstalt, n. F., Heft 17, Lamell. Rheinisch. Devon, p. 293.

Generic Characters.—Shell oval, thin, gibbose, close all round, very inequilateral. Anterior end large and expanded; posterior end almost obsolete. Umbones small, posterior, with a boss (? ligament) behind them. Under surface of umbo excavated for the ligament. Hinge edentulous. Pallial line entire. Surface ornamented with fine concentric lines, almost smooth, with fine radiating striæ in some species.

Observations.—The genus *Clinopistha* was erected by Meek and Worthen for a shell from the Coal-measures of Illinois, which had a certain affinity to *Solenomya;* but, as they point out, did not possess the ridge passing downwards and backwards from the beaks, and did not gape at either end. In addition, the shells of this genus are not transverse like *Solenomya*, but are ovate or obliquely subcircular. Hall pointed out that certain shells referred to *Dystactella* should, on grounds of priority, be now placed with *Clinopistha.* Miller enumerated seven species from Devonian and Carboniferous beds of America; and de Koninck has described three species from the Carboniferous beds of Tournai, Belgium—*C. abbreviata*, *C. lata*, and *C. parvula*,—but I strongly suspect that the first two are really only varieties of the same species. I am fortunately able to figure and describe *C. abbreviata*, de Ryckholt, and *C. parvula*, de Koninck, from British beds. Both species occur in the Fourlaws Limestone at the Coomb, a little south of the village of Redesdale, Northumberland, an horizon supposed by the Geological Survey to be the homotaxial equivalent of the lower part of the Yoredale series of Wensleydale. The rich fauna of the Limestone at the Coomb Quarry has been brought to light by the splendid work of Mr. J. Dunn, of Redesdale, and he has obtained at this place a very large number of the species which have been collected at Lowick by the Rev. E. Jenkinson, who unfortunately did not record from which of the several beds of Limestone at Lowick he obtained the fossils.

A species of the genus *Clinopistha* was recognised as a new form by de Ryckholt (*op. cit.*), who referred it to *Solemya* as *S. abbreviata* as long ago as 1853, but up to the present time no other European writer, with the exception of de Koninck, has recorded the presence of the genus. It would, therefore, appear to be very rare, and to have a very limited distribution.

The type of the genus, *C. radiata*, is the only species recorded from American Carboniferous rocks; but apparently the genus is better represented in the Devonian strata of North America. I cannot find any species described in works on European Devonian Lamellibranchs.

Beushausen (*op. cit.*) considers *Clinopistha* to be identical with the *Solenomya* of the Carboniferous rocks, and employs King's name, *Janeia*, for them; but I think it better to retain Meek and Worthen's genus for the less transverse, oval, or suborbicular forms, which are closed all round, and have given my reasons in my remarks on *Solenomya*, p. 436, for not adopting King's genus *Janeia*.

CLINOPISTHA ABBREVIATA, *de Ryckholt*, sp., 1853. Pl. L, fig. 17.

SOLEMYA ABBREVIATA, *de Ryckholt*, 1853. Mélanges paléontol., pt. 2, p. 53, pl. xvi, figs. 18, 19.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 313.
CLINOPISTHA ABBREVIATA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 123, pl. xiv, figs. 48—50; pl. xxiii, figs. 15—19.
— LATA, *de Koninck*, 1885. Ibid., p. 124, pl. xii, figs. 5, 6.

Specific Characters.—Shell of only moderate size, obliquely suboval, gibbose, very inequilateral, the posterior end being almost obsolete and much narrower from above downwards than the anterior extremity. The anterior end comprises the greater part of the valve, and is swollen and expanded; its border commences above at a more or less well-marked obtuse angle with the hinge-line, from which it descends downwards and a little forwards, and soon becomes markedly curved, forming the segment of a fairly large circle, and passes without a break into the lower border, which is convex, but much less so than the anterior margin. The posterior margin is regularly rounded, and the segment of a much smaller circle than the anterior end. The superior margin is long and almost straight in front of the umbones, but short and depressed posterior to them. The umbones are small, directed backwards, hollowed posteriorly by the escutcheon, slightly elevated and tumid, and placed very far backwards. The valves are regularly but obliquely convex, the greatest convexity at about the centre of the valve. Along the upper border, in front of the umbo, is a long obscure groove. Behind the umbones is a boss, which occupies the upper part of the escutcheon possibly representing the segment.

Interior.—The details of the interior are unknown; but the hinge is edentulous, and the internal aspect of the umbo is excavated, probably for an internal ligament.

Exterior.—The surface is ornamented with fine concentric striæ, and towards the lower border obsolete folds may be seen. The microscope reveals numerous fine radiating striæ, especially over the anterior and middle thirds of the valve. Shell thin.

Dimensions.—Pl. L, fig. 17, measures—

Antero-posteriorly	25 mm.
Dorso-ventrally (at centre of hinge-line) . .	20 mm.
From side to side (estimated) . . .	10 mm.

Locality.—The Fourlaws Limestone at the Coomb Quarry, Northumberland.

Observations.—The discovery of *C. abbreviata* in Great Britain is due to the careful work of Mr. J. Dunn, of Redesdale, to whom also we owe the discovery of another species of the genus, *C. parvula*, at the same locality.

The specimen, Pl. L, fig. 17, which is the only one which has yet been obtained, has both valves present, but unfortunately the right has its hinge-line and umbo covered by the left valve, and the latter is slightly incomplete behind, so that the curious and characteristic boss, posterior to the umbo, is not seen.

Described under the name *Solemya* by de Ryckholt, de Koninck referred the species to the genus *Clinopistha* of Meek and Worthen, but did not note the radiating lines which show the near affinity of the genus to *Solenomya*.

De Koninck described another species, *C. lata*, which he considered distinct from *C. abbreviata;* but I strongly suspect the two to be varieties of the same shell. The differential diagnosis given is as follows in his observations on *C. abbreviata:* —"Cette espèce a beaucoup de ressemblance avec la *C. lata;* elle en diffère par sa forme plus allongée et plus ovale, par sa taille plus faible et surtout par l'absence des fines côtes concentriques et régulières dont la surface des valves de la *C. lata* est ornée." These conditions probably depend on the size of the shell and its conditions of growth. Both species are said to occur at Tournai, *C. abbreviata* being stated to be very rare, and *C. lata* still rarer.

C. abbreviata is not very unlike Meek and Worthen's species *C. radiata*, var. *lævis*, which, like my specimen, possesses, as the name indicates, radiating striæ. These authors describe their shell as "having obscure radiating marks near the ventral margin, which are nearly always defined on internal casts." This species seems to be distinct from *C. abbreviata*, as its contour has not the simple continuous sweep of the latter, but is interrupted about the centre of the lower border by a contraction or sinuosity. *C. abbreviata* is easily distinguished from *C. parvula* by its obliquely ovate, convex form, the latter species being oblong and compressed, and never attaining to one fourth the size. It is to be noted that de Koninck draws attention to the fact that his figures of *C. lata* have not the regular concentric thin ribs, which he regards as of diagnostic value in the identification of the species, sufficiently well indicated.

CLINOPISTHA PARVULA, *de Koninck*, 1885. Plate L, figs. 18—20.

CLINOPISTHA PARVULA, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 124, pl. xiii, figs. 28, 29; pl. xxiii, figs. 22—25.

Specific Characters.—Shell small, very inequilateral, bean-shaped, gibbose, close all round; upper and lower margins almost parallel. The anterior end comprises nearly the whole of the valve, and is somewhat expanded and gibbose, but is rapidly compressed into the margin, which is rounded, the curvature being greater at the antero-inferior than at the antero-superior angle, which is somewhat blunted. The inferior margin is slightly convex, but is often sinuous about its centre. The posterior end is very short, compressed, depressed, and bluntly truncate. The superior margin is elevated and straight anterior to the umbo, but depressed posteriorly. The umbones are small, flattened, pointed, not raised, twisted backwards, and excavated posteriorly by the escutcheon. The valves are regularly convex, more so from above downwards than from before backwards.

Interior.—The anterior adductor muscle-scar is shallow, obliquely placed, pear-shaped, remote from the margin; the posterior scar is deeper and more rounded, occupying nearly the whole of the posterior end. Hinge edentulous. On each side of the hinge-line is a groove in which are to be seen obscure linear, elongate ridges, passing from before backwards. The inner surface of the shell is marked by obscure concentric grooves and ridges, crossed by very fine, almost microscopical radiating lines, more apparent over the front of the valve. Pallial line entire.

Exterior.—The shell is ornamented with fine concentric folds and striæ of growth. Apparently no radiating striæ. Shell thin.

Dimensions.—Pl. L, fig. 18, measures—

Antero-posteriorly	16 mm.
Dorso-ventrally	10 mm.
From side to side	7 mm.

Locality.—England: the Fourlaws Limestone, the Coomb, Redesdale, Northumberland.

Observations.—Mr. J. Dunn has obtained several specimens of this little shell from the above-named locality. De Koninck's specimens seem to have attained only to about half the size of the British examples.

The shell might easily be mistaken for *Edmondia* if not well preserved. Unfortunately none of my specimens are quite complete, and the peculiar boss, posterior to the umbo, is not seen in any of them. Three specimens, in the condition of casts, show a deep linear groove, which passes upwards from the lower margin a little way towards the umbo; but I have not been able to make out whether it is a constant and distinctive character or not.

De Koninck states that the test of this species is smooth. Pl. L, fig. 19, a larger shell than any he figures, shows fine but distinct concentric striæ.

C. parvula is more transverse than *C. abbreviata*, and much less gibbose; these species are, however, so different in every character that there is no likelihood of any difficulty arising in the differential diagnosis.

Family CONOCARDIIDÆ.

Genus Conocardium, *Bronn*, 1835.

Arcites, *Martin*, 1809. Petrefacta Derbiensia, p. 5.
Cardium, *Sowerby*, 1815. Min. Conch., vol. i, p. 187.
Bucardites (pars), *Schlotheim*, 1820. Petrefactenkunde, p. 207.
Arca, *Fleming*, 1828. Hist. Brit. Animals, p. 399.
Conocardium, *Bronn*, 1835. Lethæa Geognostica, vol. i, p. 92.
Pleurorhynchus, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 210.
Lichas, *Steininger*, 1837. Bull. Soc. Géol. France, ser. 1, tom. viii, p. 231.
Conocardium, *Agassiz*, 1840. Trad. Min. Conch., pp. 123 and 568.
Cardium, *Goldfuss*, 1841. Petrefact. Germaniæ, pt. 2, p. 213.
Conocardium, *Sandberger*, 1842. Neues Jahrb. Min., p. 397.
Cardium, *de Koninck*, 1842. Anim. Foss. Terr. Carbonif. Belg., p. 81.
Pleurorhynchus, *Portlock*, 1843. Rep. Geol. Londonderry, p. 440.
— *M'Coy*, 1844. Carb. Limest. Foss. Ireland, p. 57.
— *Garner*, 1844. Nat. Hist. Staffordshire, p. 452, pl. B, fig. 9.
— *Morris*, 1845. Cat. Brit. Foss., p. 99.
Cardium, *de Verneuil*, 1845. Géol. de la Russie, p. 301.
Conocardium, *Keyserling*, 1846. Petschoraland, p. 258.
Pleurorhynchus, *Brown*, 1849. Foss. Conch., p. 201.
— *F. A. Römer*, 1850. Geol. Nordwest. Harzgebirges, Palæontographica, vol. iii, p. 30.
Conocardium, *d'Orbigny*, 1850. Prodrome Paléontol., vol. i, p. 131.
— *de Koninck*, 1851. Anim. Foss. Terr. Carbonif. Belg. Supplement, p. 676.
— *Morris*, 1854. Cat. Brit. Foss., edit. 2, p. 194.
— *M'Coy*, 1855. Brit. Pal. Foss., p. 516.
— *Bronn and Römer*, 1856. Lethæa Geognostica, vol. i, p. 419.
— *Woodward*, 1856. Manual of Mollusca, p. 292.

Conocardium, *Hall*, 1858. Trans. Albany Inst., vol. iv, p. 15.
— *Eichwald*, 1860. Lethæa Rossica, p. 1021.
Pleurorhynchus, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
Conocardium, *Wardle*, 1862. In Sleigh's Ancient Hist. Leek, p. 285.
— *Winchell*, 1862. Proc. Acad. Nat. Sci. Philadelphia, p. 420.
— *Meek and Worthen*, 1865. Ibid., p. 249.
— *Dawson*, 1868–78. Acadian Geology, p. 304.
— *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, p. 50.
— *Stoliczka*, 1871. Pal. Indica, vol. iii, p. 211.
Pleurorhynchus, *Baily*, 1871. Journ. Roy. Geol. Soc. Ireland, vol. iii, p. 25.
Conocardium, *R. Etheridge, jun.*, 1873. Geol. Mag., vol. x, pl. xii, fig. 5, p. 297.
— *Meek and Worthen*, 1875. Geol. Surv. Illinois, vol. vi, p. 529.
Pleurorhynchus, *Baily*, 1875. Figs. Char. Brit. Fossils, p. 115.
Conocardium, *Armstrong, Young, and Robertson*, 1876. Cat. W. Scott. Foss., p. 53.
— *Römer*, 1876. Lethæa Palæoz. Atlas, pl. xliv, fig. 4.
Pleurorhynchus, *Kinahan*, 1878. Man. Geol. Ireland, pl. iii, face p. 63.
Conocardium, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
— *Whitfield*, 1882. Bull. Amer. Mus. Nat. Hist., vol. i, no. 3, p. 61.
— *Collett*, 1883. Twelfth Ann. Rep. Geol. Indiana, p. 347.
— *Hall*, 1884. Nat. Hist. New York, Pal., vol. v, pt. 1, no. 2, p. xxxiv.
— *Walcott*, 1884. U.S. Geol. Surv. Pal. Eureka Distr., p. 177.
— *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 99.
— *R. Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.
— *Miller*, 1889. N. Amer. Geol. and Palæont., p. 472.
— *Worthen*, 1890. Geol. Surv. Illinois, Pal., vol. viii, p. 112.
— *Whidborne*, 1891. Monograph Devonian Fauna, vol. ii, pt. 1, p. 18.
— *Keyes*, 1894. Missouri Geol. Surv., vol. v, p. 124.
— *Tornquist*, 1896. Fossilführ. Untercarbon. Südvogesen, p. 106; Abhandl. geol. Specialkarte Elsass-Lothringen, vol. v, p. 640.

Generic Characters.—Shell equivalve, very inequilateral, more or less fusiform or triangular, rapidly compressed and truncated behind so as to form in the majority of the species of the genus a posterior surface, which is cordiform and often concave, bisected by a slight median ridge formed by the closed edges of the valve, from the upper part of which springs the characteristic tubular rostrum. The anterior end is triangular and produced, gradually narrowed and compressed, consisting of the wing and lateral surface of the valve, gaping largely. The anterior border is curved, forming a right angle with the hinge-line; it descends for a short distance and then rapidly curves backwards and downwards in a single sweep or sinuous till it meets the postero-inferior angle of the dorsal surface.

The hinge-line is straight, produced in front, elongated posteriorly, and continuous with the upper margin of the tubular rostrum. The umbones are small, pointed, incurved, contiguous, much cut away behind by the compression of the posterior surface, often carinate: they are remote from the anterior extremity. Passing obliquely downwards and backwards from the umbones to the postero-inferior angle is a well-marked ridge or rounded gibbosity, which separates the lateral from the posterior surface; a process of shell is often to be found, as a wide flange, extending beyond this ridge, with much the same direction. The lateral surface is convex, the convexity increasing in degree to the extreme posterior margin; but there is a well-marked narrow sulcus, which passes downwards and slightly forwards. Starting immediately in front of the umbo, and becoming wider and deeper as it passes across the valve, this sulcus shows itself as a well-marked indentation in the lower border. In front, the upper edge of the valve is curved inwards on itself.

Interior.—Anterior adductor muscle-scar large, deep, bounded behind by a thick oblique ridge. Posterior adductor scar shallow and almost obsolete, placed on the posterior surface remote from the margin. Cavity of the shell smooth. The margin is roughened in front, but soon shows several interrupted, distinct, short ribs, which become smaller and smoother (? worn) as they pass backwards. Immediately posterior to the byssal groove the edge of the valve is guarded by alternate, elevated, pointed teeth, and corresponding sockets, which become slightly smaller as they pass backwards; these appear at the extreme postero-inferior angle of the left valve to be a single rounded socket of larger size than any of the others. The posterior margin is also marked on its inner surface with smaller, but sharp, narrow, pointed teeth, alternate with corresponding sockets, diminishing in size from below upwards. Immediately below the umbones, on a plane external to their apices, is a flattened hollowed plate, the anterior end of which terminates abruptly; but its base is continuous with the ridge posterior to the anterior adductor scar. This plate supports the ligament, which is situated thus partly internal and partly external. There is no evidence of the presence of hinge-teeth in the ordinary sense of the term.

Exterior.—The surface is covered with radiating ribs, often much obscured by shell-growth, but very apparent when the outer layer of shell is removed. The posterior surface is ornamented in the same way by curved ribs and narrow sulci, closer together than on the lateral surface. In the perfect condition the surface is almost smooth, with fine, close, almost microscopic lines of growth, occasionally interrupted by deeper grooves.

Shell very thick. The inner surface is smooth and compact, and is separated from the outer, also nearly smooth, by a numerous series of radiating cellular ribs, divided into spaces transversely by thin lamellæ of shell. These ribs are much larger and farther apart in the anterior part of the shell, and closest and narrowed on the posterior surface.

Observations.—The systematic position of *Conocardium* has been a matter of much difference of opinion. Agassiz thought the genus belonged to the Brachiopoda. Other observers thought it had a greater affinity to *Cardium*. Others again referred it to *Lunulicardium*, a genus of Palæozoic shells whose internal characters have not yet been observed. There is no one character, however, which permits *Conocardium* to be referred to *Cardium;* and, indeed, the peculiarities of the genus are so well marked, and they differ from all known genera so thoroughly that I do not hesitate to adopt the family *Conocardiidæ* to receive the genus. At the same time it is very difficult, if not impossible, to assign this family its proper systematic position.

Of recent shells, *Tridacna* has the greatest superficial resemblance to *Conocardium;* but it cannot be said that any of the peculiar characters of the latter genus are to be noted in *Tridacna.*

There has always existed considerable doubt as to the proper orientation of the shell of *Conocardium*, several authors—Woodward, Barrande, Hall, and Halfar—considering the tubular process to be posterior, and to have contained the siphonal tubes; others—de Koninck, Fischer, Neumayr, and Beushausen—maintaining the reverse. After long consideration, and the examination of very perfect specimens of the interior, I consider that the anatomical evidence is in favour of the view that the truncated end with the prolonged rostrum is posterior. The facts which have caused me to arrive at this opinion are the following:

Pl. LI, fig. 10, a very perfect example of *Conocardium Herculeum* from Tournai, shows remains of the external ligament, which occupies a depression between the umbones and the long rostrum; and this surely cannot be placed anterior to the umbones. The anterior adductor scar is in ordinary bivalves the deeper and better marked, and in many genera is bounded behind by a ridge of shell; in *Conocardium* (Pl. LI, fig. 11 *a*) the muscle-scar, *b*, at the compressed and produced end of the valve is very well-marked, and there is a strong ridge which bounds its posterior margin, which in itself would, I think, make the extrusion and withdrawal of siphon-tubes impossible, for this ridge is continued to within a short distance from the margin of the valve. The posterior adductor is, as generally obtains in bivalves, shallow and indistinct, and is remote from the margin of the shell, and in the normal position, if the truncated, expanded surface of the shell be regarded as a very accentuated dorsal slope.

Between the wing and the body of the shell is a well-marked constriction, corresponding, I think, to the byssal sulcus in other genera; and where this fold meets the margin the peculiar ridges on the inner edge of the valve are markedly worn. The shell, it is true, gapes very considerably at the winged end, but I

Arca rostrata, *Fleming*, 1828. Hist. Brit. Anim., p. 399.
Pleurorhynchus elongatus, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 211, pl. v, fig. 28.
Cardium elongatum (pars), *Goldfuss*, 1841. Petrefact. Germaniæ, vol. ii, p. 214, pl. cxlii, figs. 2 *a*, *b*.
— rostratum, *de Koninck*, 1842. Anim. Foss. Terr. Carbonif. Belg., p. 87, pl. ii, fig. 9.
Pleurorhynchus elongatus, *Morris*, 1843. Cat. Brit. Foss., 1st edit., p. 99.
Cardium Ouralicum, *de Verneuil*, 1845. Géol. Russie, p. 301, pl. xx, fig. 11.
Pleurorhynchus elongatus, *Brown*, 1849. Illust. Foss. Conch. Gt. Brit., p. 201.
Conocardium rostratum, *d'Orbigny*, 1850. Prodrome Paléontol., vol. i, p. 132.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 195.
— — *M'Coy*, 1855. Brit. Pal. Foss., p. 517.
— uralicum, *Eichwald*, 1860. Lethæa Rossica, p. 1022.
Cardium elongatum, *Hellmann*, 1862. Petrefact. Thuringens, pl. xvii, figs. 43—45.
? Conocardium aliforme, *Römer*, 1876. Lethæa Geognostica, pl. xliv, fig. 4.
— elongatum, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
— rostratum, *Bigsby*, 1878. Ibid., p. 303.
— uralicum, *Bigsby*, 1878. Ibid., p. 303.
— rostratum, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 115, pl. xx, figs. 16—19.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.

Specific Characters.—Shell very inequilateral, much elongated anteriorly, subfusiform, not so rapidly compressed posteriorly as the majority of the species of the genus, so that a posterior surface is absent. The anterior end is prolonged forwards, and is narrow, subcylindrical, slightly compressed from side to side, truncate, and gaping. The anterior border is very short, and makes a right angle with the extremity of the hinge-line; it then descends downwards and backwards, passing into the lower border. This is sinuous, convex at first, and soon becomes concave till the lowest point of the valve is reached, marked by the meeting of the ridge or keel with the lower border. From this point the margin becomes bent upwards and backwards at an angle, and becomes continuous with the lower border of the rostrum. The hinge-line is straight, very elongate, continuous behind with the upper border of the rostrum.

The umbones are small, incurved, pointed, not raised, and are almost equidistant from the tip of the rostrum behind and the antero-superior angle in front. Passing directly downwards from the umbo to the inferior border is a rounded and very blunt keel, which separates the anterior and posterior parts of the valve. This keel marks the greatest gibbosity of the valve; and in front of it the valve is gradually compressed from side to side, and narrowed from above downwards into

The only other important synonym is *Conocardium ouralicum* of de Verneuil. That author considered that the Russian shells, even in the best state of preservation, always showed radiating ribs, and that the anterior subcylindrical portion of the valve was separated from the body by a sinus. I can state with certainty that the latter character exists in many specimens of *Conocardium rostratum;* and the former character I believe to be present or not according to the age, size, and condition of preservation of the shell. Even de Verneuil does not show that his shell has a rostrum. M'Coy pointed out the identity of the *C. rostratum* and *C. ouralicum;* and I agree with every word of his observations on this subject. De Koninck unfortunately never saw the rostrum, for he states (*op. cit.*, 1885), "Elle semble y être dépourvue de long rostre;" but Pl. LI, fig. 7, leaves no room to doubt that this process was as long as, if not comparatively longer than, in any species of the genus.

C. rostratum does differ, however, from nearly all the other species in the small amount of truncation of the posterior end and the absence of a posterior flat or even concave surface; and, moreover, it appears to have had no shelly fringe or flange extending backwards from the keel, which is less angular than is usual in the genus.

No other British species can possibly be confounded with this one; but de Koninck has described *C. subrostratum*, which, he says, is "much less fusiform, its cordate region is much better limited, and the ornaments of the surface are quite different." A fine series of this species from Settle is in the Burrows Collection in the Woodwardian Museum of Cambridge. The Museum of the Geological Survey at Jermyn Street also contains a fine series showing different stages of growth, from the Carboniferous Limestone of Derbyshire.

De Koninck thinks that the shell figured as *Conocardium aliforme* by Römer (*op. cit.*) should more correctly be referred to *C. rostratum.* This view is probably correct, but the drawing is bad, and it is impossible to be absolutely certain about the matter.

CONOCARDIUM IRREGULARE, *de Koninck*, 1842. Plate LI, figs. 12, 13.

CARDIUM IRREGULARE, *de Koninck*, 1842. Anim. Foss. Terr. Carbonif. Belg., p. 88, pl. iv, fig. 14.
CONOCARDIUM IRREGULARE, *d'Orbigny*, 1851. Prodrome Paléont., vol. i, p. 132.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
— — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 117, pl. xx, figs. 23—25.

Specific Characters.—Shell small, almost equilateral, transversely triangular, strongly keeled, compressed both in front and behind. The anterior wing is small, triangular, separated from the body of the valve by a slight oblique compression, pointed and gaping at the extremity. The inferior margin descends downwards and backwards to the lowest point of the valve, and then becomes rapidly bent, and passes upwards and backwards to the base of the rostrum. The hinge-line is straight and prolonged, continuous with the upper margin of the rostrum. The umbones are small, angular, pointed, and slightly raised above the hinge-line; the rostrum long-pointed, springing from a very elongate base, and supported by a triangular ribbed process of shell. The valve has really no posterior surface, but a triangular lateral surface, the anterior and posterior parts being inclined to each other at a very large angle, and meeting in a strong vertical ridge, which passes from the umbo to the lower margin, the posterior portion representing the posterior surface in other species of the genus.

Interior.—The details of the hinge and muscle-scars are unknown.

Exterior.—The anterior half of the shell is smooth and marked by concentric lines of growth, which are parallel with the lower border. The median part of the valve is marked by a strong vertical, angular rib, which passes from the umbo to the lower border, behind which are others, distinct and separate, but less strongly marked, and diminishing in size from before backwards. The base of the rostrum is also covered with short oblique ribs. Shell comparatively thick.

Dimensions.—Pl. LI, fig. 12, a specimen from Settle, in the Woodwardian Museum, measures—

Antero-posteriorly	10 mm.[1]
Dorso-ventrally	5 mm.
From side to side (estimated from one valve) .	5 mm.

Locality.—The Carboniferous Limestone of Settle, Yorkshire.

Observations.—This very distinct and peculiarly marked species has been described by de Koninck, in both his great works, from the Carboniferous Limestone of Visé. I have only met with two specimens of the species in Great Britain, and both are in the Burrows Collection of the Woodwardian Museum, Cambridge.

The absence of ribs on the anterior part and the few strong ribs on the posterior part, separated by the first rib, which makes a strong ridge dividing the shell, the absence of a posterior surface, and the elongate ribbed base of the rostrum are important characters for the recognition of the species. *C. rostratum* has somewhat analogous shape, but has not the peculiarly characteristic ribs of *C. irregulare.* M. Fraipont, who, it seems, furnished the description for this shell for the latter of de Koninck's great works, has not, I think, pointed out the absence of a posterior surface. He says the median part of the shell has three ribs stronger than the others, and that the cordiform surface has four oblique ribs. Although my description differs greatly from his, I think the difference is chiefly in the method of dealing with the peculiar shape of the valve.

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[1] N.B.—It is difficult to differentiate between the rostrum and the prolonged posterior end of the valve.

Unfortunately both specimens are incomplete behind, and I have been unable to see the base of the rostrum. De Koninck describes a cordiform surface in this position.

CONOCARDIUM INFLATUM, *M'Coy*, sp., 1844. Plate LI, figs. 14—17.

PLEURORHYNCHUS INFLATUS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 59, pl. ix, fig. 2.
CONOCARDIUM INFLATUM, *d'Orbigny*, 1851. Prodrome Paléontol., p. 131.
— ARMATUM (pars), *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 194.
PLEURORHYNCHUS INFLATUS, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
CONOCARDIUM INFLATUM, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 106, pl. xix, figs. 11—14.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.
? — — *Tornquist*, 1896. Fossilführ. Untercarbon. Sudvogesen; Abh. geol. Specialkarte Elsass-Lothr., pt. 2, vol. v, p. 116, pl. xviii, fig. 12.

Specific Characters.—Shell very inequilateral, triangularly conical, swollen, comparatively transverse. The anterior end is alate, produced, triangular, cut away at the expense of its lower margin, gaping, and truncate, its extremity narrow and curved, marked off from the swollen body of the shell by a gentle constriction, oblique in direction. The inferior margin is gently convex, the convexity slightly interrupted at the junction of the anterior wing and the body of the valve, becoming more convex posteriorly, where the border passes upwards to end at the postero-inferior angle. The hinge-line is straight and elongated, continuous behind with the upper margin of the rostrum.

The umbones are small, pointed, incurved, contiguous, very slightly elevated, swollen, compressed posteriorly. Passing downwards and outwards and backwards from the umbones to the postero-inferior angle is a curved line, which marks off the body of the valve from the posterior surface. The latter is small, cordate, convex, bisected by an elevated vertical ridge, formed by the everted edges of the opposing valves, continuous above with the raised base of the rostrum. The rostrum has a comparatively large diameter. The posterior surface is oblique, at an angle of about 20° with the hinge-line. The body of the valve is very tumid, and expanded triangularly; its posterior margin is not keeled or sharp, nor does it correspond with the line of greatest convexity, but is at some distance behind it. Valves curved on themselves from above downwards. A short, thick flange extends from the lower part of the external margin of the posterior surface.

Interior.—As far as can be seen, exactly like that of *C. Herculeum.*

Exterior.—The surface was probably smooth; but in the condition in which the type specimen exists there are regular, equidistant, radiating ribs, fewer in number and further apart on the anterior wing. Shell thick, composed of several layers, the intermediate ones composed of cellular ribs.

Dimensions.—Pl. LI, fig. 14, the type of M'Coy's *Pleurorhynchus inflatus,* measures—

Antero-posteriorly (estimated; type incomplete in front)	20 mm.
Dorso-ventrally	16 mm.
From side to side	16 mm.

Localities.—England: the Carboniferous Limestone of Derbyshire; Withgill; Hill Stebden, Hill Bolton, Yorkshire. Ireland: the Carboniferous Limestone of Carrickboy, Longford, and Claines; Doohybeg and Ragreah, co. Limerick. Scotland: the Lower Limestone series of Corrieburn, near Kilsyth.

Observations.—The type of this species is preserved in the Griffith Collection in the Royal Museum of Science and Art, Dublin; and I am permitted to refigure it by the kindness of the authorities. It is quite possible that this species is only a variety of *C. aliforme,* which it closely resembles; but the following differences are noticeable: it is comparatively more gibbose and transverse; the posterior surface is more oblique, less flattened, and concave; the body of the valve is less suddenly bent and adpressed to form the posterior surface. The type has unfortunately lost the greater part of its anterior end and its rostrum. I have been able to find very few specimens which can be referred to *C. inflatum.* Three specimens from Irish localities are, however, in the Woodwardian Museum, which also possesses a specimen labelled Derbyshire, which should, I think, be referred to this species; and I have also collected a few specimens from the Yorkshire localities noted above, which possess the peculiar characters of *C. inflatum* to which I have drawn attention above.

De Koninck recognises the presence of *C. inflatum* in Belgium, at Anseremme, Étage II, and separates the species from *C. aliforme* "par sa forme plus allongée, son extrémité antérieure plus obliquement tronquée, et son rostre plus grêle."

C. eximium and *C. intermedium* of de Koninck seem to be not unlike the species under discussion.

Conocardium aliforme, *Sowerby*, sp., 1815. Plate LIV, figs. 1—10.

Cardium alæforme, *Sowerby*, 1815. Min. Conch., vol. vi, p. 100, pl. dlii, fig. 2.
— — *Fleming*, 1828. Hist. Brit. Animals, p. 423.
Pleurorhynchus minax, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 210, pl. v, fig. 27.
Non — — — 1841. Palæoz. Foss. Cornwall, p. 33, pl. xvii, fig. 50.
— armatus, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 211, pl. v, fig. 29.
Cardium alæforme, *Agassiz*, 1840. Trad. Min. Conch., p. 569, pl. ccclix, fig. 3.
— — *de Koninck*, 1842. Anim. Foss. Terr. Carb. Belgique, p. 83, pl. iv, fig. 12.
Non Pleurorhynchus aliformis, *Phillips*, 1841. Pal. Foss. Cornwall, etc., p. 34, pl. xvii, fig. 51.
— minax, *Portlock*, 1843. Rep. Geol. Londonderry, p. 440.
— — *M'Coy*, 1844. Synopsis Carb. Foss. Ireland, p. 59.
— aliformis, *M'Coy*, 1844. Ibid., p. 57.
— armatus (?), *M'Coy*, 1844. Ibid., p. 57.
— aliformis, *Morris*, 1845. Cat. Brit. Foss., 1st edit., p. 99.
— armatus, *Morris*, 1845. Ibid., p. 99.
— minax, *Morris*, 1845. Ibid., p. 99.
Conocardium aliforme, *Bronn*, 1848. Nomencl. Palæontol., p. 324.
— armatum, *Bronn*, 1848. Ibid., p. 324.
Pleurorhynchus aliformis, *Brown*, 1849. Illust. Foss. Conch., p. 201, pl. lxxxii, figs. 24, 25.
— armatus, *Brown*, 1849. Ibid., pl. lxxxii, fig. 11.
— minax, *Brown*, 1849. Ibid., p. 202, pl. lxxxii, fig. 17.
Conocardium alæforme, *d'Orbigny*, 1850. Prodrome Paléont., vol. i, p. 132.
— minax, *d'Orbigny*, 1850. Ibid., p. 132.
— aliforme, *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 194.
— armatum, *Morris*, 1854. Ibid., p. 194.
— minax, *Morris*, 1854. Ibid., p. 195.
— aliforme, *M'Coy*, 1855. Brit. Pal. Foss., p. 516.
— — *Eichwald*, 1860. Lethæa Rossica, vol. i, p. 1023.
Pleurorhynchus aliformis, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
Conocardium minax, *Griffith*, 1860. Ibid., p. 91.
Non — aliforme, *Young and Armstrong*, 1871. Trans. Geol. Soc. Glasgow, vol. iii, Supplement, p. 50.
— — armatum, *Young and Armstrong*, 1871. Ibid., p. 50.
— — aliforme, *Armstrong, Young, and Robertson*, 1876. Cat. West. Scott. Foss., p. 53.
— — armatum, *Armstrong, Young, and Robertson*, 1876. Ibid., p. 53.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
— minax, *Bigsby*, 1878. Ibid., p. 303.
— aliforme, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. ix, p. 107, pl. xviii, figs. 15—17.

CONOCARDIUM MINAX, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belgique, vol. xi, p. 111, pl. xix, figs. 22—25.
— ARMATUM, *de Koninck*, 1885. Ibid., p. 110, pl. xix, figs. 19—21.
— ALIFORME, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.
— ARMATUM, *Etheridge*, 1888. Ibid., p. 281.
— MINAX, *Etheridge*, 1888. Ibid., p. 281.
? — ALIFORME, *Tornquist*, 1896. Fossilführ. Untercarbon. Sudvogesen; Abh. geol. Specialkarte Elsass-Lothringen, vol. v, p. 644 [p. 110], pl. xxiii, fig. 13.

Specific Characters.—Shell below medium size, trigonal, gibbose in the middle portion, no keel, anterior wing triangular, conical, dilated, but narrowed from above downwards. The anterior end gapes widely and is twisted on itself, separated from the body of the valve by a gradual constriction, in front of which it expands again. The anterior border is short and convex. The superior border descends at first with a convex curve, but becomes concave just anterior to the junction of the main and anterior portion of the valves; posterior to this it becomes markedly convex, till it passes backwards and upwards, bisecting the posterior surface, terminating in the base of the rostrum. The hinge-line is straight and elongate, continuous posteriorly with the upper border of the rostrum.

The posterior surface is comparatively large, cordate; as a whole slightly convex, but very gently concave around the base of the rostrum. Posterior surface is placed almost vertically to the long diameter of the shell, and is divided by a well-marked excentric line into two parts, the upper of which is concave and more markedly ribbed than the lower.

The body of the valve is triangularly swollen, but the lateral surface passes into the posterior surface with a rapid curve, and no ridge or keel. The umbones are small, pointed, incurved, and somewhat flattened on their posterior aspect; the lunule elongate, broad, and well marked. The rostrum appears to have been long and delicate.

Interior.—As in *C. Herculeum*, de Koninck.

Exterior.—The surface is covered by fine radiating ribs, crossed by almost obsolete concentric lines of growth. The better preserved the shell the finer are the markings; and if the other layers of the shell be removed, much more marked and fewer, but thicker ribs are seen, the thick ribs being alternate to the ribs of the opposite valve. Shell thick.

Dimensions.—Pl. LIV, fig. 6, measures—

Antero-posteriorly	20 mm.
Dorso-ventrally	15 mm.
From side to side	15 mm.

Localities.—England: the Carboniferous Limestone of Hill Bolton, near

Grassington; Dunmow Quarry, Slaidburn; Teenley Quarry and Settle, Yorkshire; Park Hill and Thorpe Cloud, Derbyshire; Narrowdale, Staffordshire; the Fourlaws Limestone, the Coomb, Redesdale. Ireland: the Carboniferous Limestone of Queen's Co., Enniskillen, co. Fermanagh. Scotland: the Lower Limestone series of Corrieburn, Kilsyth.

Observations.—The specimens figured by Sowerby (*op. cit.*) as the types of *Cardium alæforme* are preserved in the Sowerby Collection in the British Museum (Natural History), Cromwell Road, and I am permitted to refigure them, Pl. LIV, figs. 1 and 2, by the kindness of the authorities. Neither specimen is perfect, but both of them are sufficiently typical of the general character of the species; and I do not agree with Prof. Phillips that the lower figure, of which only the posterior end was shown, appears to belong to his *Pleurorhynchus minax.*

I have no doubt that *Cardium armatum*, Phillips, is the young of *C. alæforme*, Sow., and I refigure the type of this species, which is preserved in the Gilbertson Collection in the British Museum (Natural History branch), Pl. LIV, fig. 3.

De Koninck in 1842 (*op. cit.*) considered these two species and *P. minax* to be identical, but in his later work reversed this opinion. He states that *C. armatum* is distinguished from *C. aliforme* by being much less oblique, with a more slender rostrum, and by a larger number of radiating ribs. The first two of these distinctions so evidently depend on the state of growth of the shell that no further discussion is necessary. Moreover, the number of radiating ribs depends on the layer of shell which is examined, the lower layers having much fewer ribs than the surface—a fact shown in Sowerby's type, Pl. LIV, fig. 2, but on the opposite side to that figured.

C. minax is a species about which there has always existed a great deal of uncertainty, and unfortunately there is no type to refer to, as the specimen which served for the description by Phillips has disappeared. Added to this is the fact that Phillips thought that the lower figure of *C. aliforme* of Sowerby was *P. minax;* and that de Koninck, in his early work, and M'Coy considered Phillips's species a synonym of Sowerby's *C. aliforme.*

Phillips's figure seems to me to have been an impossible one, and to have been drawn at the same time from two points of view; and unfortunately the description, which is as follows—"anteriorly gibbous and rounded, posteriorly elongate, rostrum attenuated, radiating furrows equal"—is too meagre to permit any decision to be formed from it: at the same time it presents no marked differences from *C. aliforme.*

De Koninck in his later work (*op. cit.*) has re-described *C. minax*, but his figure seems to me to have little in common with that of Phillips, and to be quite different from the specimens labelled *C. minax* in our museums. It is a small individual with apparently a much closer affinity to *C. inflatum.*

Unfortunately, too, Phillips, at a later date (1841), referred a shell from the Devonian strata to *P. minax*, a reference criticised by nearly all later writers; and in the same work he refers a shell to *C. aliforme*, Sow., which has no affinity whatever with that species.

Under these circumstances, therefore, and from the examination of a large series of specimens I am unable to recognise more than one species, and have placed *P. minax*, Phillips, as a synonym of *C. aliforme*. An examination of Sowerby's types of the latter shell, Pl. LIV, figs. 1 and 2, demonstrates that there are no grounds for Phillips's opinion that the shells belong to different species. They are not, it is true, equally well preserved, for fig. 2 is incomplete in front. The examination of many tablets of these shells in several museums shows that the names *C. aliforme* and *C. minax* are used for the same shells indiscriminately.

Specimens of this species vary also as to the extent of the angle made by the posterior and lateral surfaces. If figs. 6 *a* and 8 *b*, Pl. LIV, be compared, the latter is seen to have a much flatter posterior surface than the former, and the angle made by the meeting of the posterior and lateral surfaces is much more acute and less bevelled off. Indeed, in a large series of examples, forms intermediate between *C. inflatum* and *C. aliforme* would seem to occur, *e. g.* Pl. LI, fig. 17, and Pl. LIV, fig. 7.

Specimens from the Coomb, Redesdale, show that the outer surface was almost smooth, and that the ribbed appearance is due to partial decortication. Fig. 5, Pl. LIV, is a specimen showing the cast of the interior. The anterior part shows two slits, which lodged thin shelly processes. The upper one, only slightly divergent from the line of the hinge, the lower, placed at a much greater angle; between them is an elevated, smooth, round, almost semiconical elevation corresponding with a hollow in the shell. Other slighter oblique ridges pass obliquely from the umbo to the border, which would have left a groove in the interior of the shell. This specimen is different in this respect from the interior shown, fig. 11 *a*, Pl. LI. The lower groove in fig. 5, Pl. LIV, corresponds with the ridge marked *b* in the former, the upper groove being for the reception of the lower edge of the hinge-plate.

C. aliforme varies very much in the condition of the posterior surface; at times the excentric concavity round the base of the rostrum is very well marked, especially in very young specimens; in others hardly any concavity is to be noted.

Some specimens show that there was a shelly extension of very small degree attached to the excentric line on the posterior surface,—quite rudimentary, however, when compared with the same process in *C. Hibernicum*.

Conocardium Konincki, *Baily*, sp., 1871. Plate LIV, figs. 11—13.

Pleurorhynchus Konincki, *Baily*, 1871. Journ. R. Geol. Soc. Ireland, vol. iii, p. 25, pl. iv, fig. 1.
Conocardium Konincki, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
— — *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 105, pl. xix, figs. 1—4.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.

Specific Characters.—Shell above medium size, very inequilateral. The anterior portion triangular and compressed, alate; the body very gibbose, obliquely and triangularly swollen, truncate, and adpressed posteriorly to form a cordate posterior surface.

The anterior end is curved on itself from above downwards, and is prolonged in the form of a triangular wing, marked off from the convex body of the shell by a rapid, oblique, broad constriction. The anterior extremity is much narrowed at the expense of its lower border, truncate and gaping; the antero-superior angle forms a rounded right angle. From this point the border descends, and curves downwards and backwards, until it approaches the gibbose body of the valve, when the inferior border curves so rapidly downwards that it becomes concave till it passes into the inferior border of the main mass of the shell, which, curving slightly upwards to join the elevated edge of the valve at the postero-inferior angle, becomes markedly convex. The upper margin is straight and prolonged, continuous posteriorly with the upper margin of the rostrum, which is produced slightly upwards and backwards, making a very large angle with the hinge-line.

The posterior surface is large, cordate, oblique to the main mass of the shell; its outer portion is convex, the middle excentrically concave, but towards the margin of the valve, which is in contact with its opponent, it becomes raised into a ridge, which passes from the postero-inferior angle to the base of the rostrum. The rostrum is large, long, and tubular, rising gradually from the upper part of both valves of the shell.

The umbones are large, gibbose, incurved, and twisted slightly backwards; somewhat elevated above the hinge-line, cut away posteriorly, and flattened by the rapid compression of the valve to form the posterior surface.

Passing obliquely downwards and backwards from the umbo to the postero-inferior angle is a rounded ridge, which separates the lateral surface from the posterior surface, and reaches the inferior border at the postero-inferior angle.

Interior.—The inner surface of the shell is smooth, and, as far as details have been obtained, the muscle-scars, hinge-plate, etc., agree with that of *C. Herculeum* described above.

CONOCARDIUM FUSIFORME, *M'Coy*, sp., 1844. Plate LII, figs. 1 and 2.

PLEURORHYNCHUS FUSIFORMIS, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 58, pl. ix, fig. 3.
CONOCARDIUM FUSIFORME, *d'Orbigny*, 1851. Prodrome Paléontol., p. 131.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 194.
— — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.
Compare — HERCULEUM, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 103, pl. xviii, figs. 1—6.
— FUSIFORME, *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.

Specific Characters.—Shell large, triangularly fusiform, obliquely gibbose and truncate, adpressed posteriorly, forming a concave posterior surface, placed obliquely to the general direction of the shell, and compressed in front, forming a broad triangular wing, which is gradually compressed; separated from the body of the valve by an almost obsolete constriction. The anterior alate portion of the valve is triangular, curved on itself, gradually narrowed at the expense of its lower border, truncate, and gaping; its margin, narrow and curved, passes into the lower border, which is directed downwards and backwards to the postero-inferior angle, becoming concave or sinuous at the point where the anterior alate portion joins the gibbose body of the valve. The hinge-line is straight and long, continuous behind with the upper border of the large rostrum. The umbones are large, gibbose, incurved, not contiguous, flattened behind by the truncation of the valve to form the posterior surface. The posterior surface is cordate and deeply concave, except along the margin of the valves, which, as is usual in the genus, forms a vertical elevated ridge bisecting the posterior surface, and terminating above in the raised base of the rostrum. The outer margin of this surface is formed by a bluntly rounded curved ridge, which projects backwards and extends from the apex of the umbo to the postero-inferior angle. The rostrum is large, long, and tubular; springing from a raised base, continuous above with the hinge-line. The body of the valve is oblique and very gibbose, not well marked off from the anterior wing; and, viewed from behind, the valves seem much curved on themselves.

Interior.—The details of the interior differ in no way from the description given of *C. Herculeum* when defining the genus, p. 451.

Exterior.—Surface almost smooth, with fine concentric lines of growth, more marked and rougher towards the lower margin.

Shell very thick, inner and outer layers smooth; inner layers with well-marked radiating ribs.

Dimensions.—Pl. LII, fig. 1, the type figured by M'Coy as *Pleurorhynchus fusiformis*, measures—

Antero-posteriorly	130 mm.
Dorso-ventrally	95 mm.
From side to side	82 mm.

Shell somewhat crushed.

Localities.—Ireland: the Carboniferous Limestone of Malahide, co. Dublin; Hook Head, co. Wexford; Bushy Island, co. Limerick.

Observations.—The type specimen figured by M'Coy is fortunately preserved in the Griffith Collection in the Museum of Science and Art, Dublin, and I am permitted to refigure it by the kindness of the authorities. It is a very fine and large example, with the right valve somewhat crushed into the left, but the latter retains the outer coating of shell. This species occurs in large numbers in a bed of limestone on the foreshore at Malahide, co. Dublin. Sections of these have been worn down by wave action, but they are so intimately attached to the matrix that it is almost impossible to extract specimens.

C. fusiforme is distinguished at once from *C. Konincki* by the want of a marked constriction between the body of the valve and the anterior wing; but it seems to me very probable that the *C. Herculeum*, de Koninck (Pl. LI, figs. 10 and 11), is only a less fully grown example of M'Coy's species. De Koninck writes of his species, "Il offre beaucoup plus de ressemblance avec le *C. fusiforme*, F. M'Coy, auquel je l'ai assimilé pendant quelque temps, mais qui s'en distingue par le faible développement de la grande concavité de sa lunule cordiforme, ainsi que par la longueur et la forme cylindrique de son rostre."

It is certain that none of the figured specimens of *C. Herculeum* have so concave a posterior surface as the picture of this portion of the shell given by M'Coy; but this was very largely idealistic, for the type is crushed and not well developed in this position. I possess a specimen of the Belgian shell which has a very concave posterior surface, which shows that the concavity depends on the extent of the growth of the outer margin of the posterior surface, corresponding to the flange of *C. Hibernicum.* With regard to the question of the extent and shape of the rostrum, de Koninck describes this process as being broad, terminating in a point, and never prolonged as a cylindrical tube. This may be the case, or it may well be that specimens have never been obtained which had such a fragile and brittle portion preserved. Little or nothing, on the other hand, is known of the condition of the rostrum in *C. fusiforme;* I have seen no specimens in which it is preserved. The base of this process is only preserved in M'Coy's specimen, Pl. LII, fig. 1, but in his description he mentions it as "the slender conical tube." The young and intermediate stages of the growth of *C. fusiforme* are quite unknown, and, curiously enough, all the specimens at Malahide seem to have arrived at mature growth.

Conocardium Hibernicum, *Sowerby*, sp., 1815. **Plate LII, figs. 3 and 4; Plate LIII, figs. 6—11.**

Cardium Hibernicum, *Sowerby*, 1815. Min. Conch., vol. i, p. 187, pl. lxxxii, figs. 1, 2.
— — *Lamarck*, 1819. Anim. sans Vert., vol. vi, p. 20.
— — *J. de C. Sowerby*, 1827. Min. Conch., vol. vi, p. 100, pl. dlii, fig. 3.
— — *Fleming*, 1828. Hist. Brit. Anim., p. 423.
Pleurorhynchus Hibernicus, *Phillips*, 1836. Geol. Yorks., pt. 2, p. 210, pl. v, fig. 26.
— trigonalis, *Phillips*, 1836. Ibid., p. 211, pl. v, figs. 30—32.
? Cardium Hibernicum, *Goldfuss*, 1836–40. Petrefact. Germaniæ, vol. ii, p. 213, pl. cxli, figs. 6 *a*, *b*.
Conocardium Hibernicum, *Agassiz*, 1840. Trad. Min. Conch., p. 123, pl. lx, figs. 1—3; p. 568, pl. ccclix, fig. 4.
Non Cardium Hibernicum, *de Koninck*, 1842. Anim. Foss. Terr. Carbonif. Belg., p. 85, pl. iv, figs. 13 *a*, *b*.
Pleurorhynchus Hibernicus, *M'Coy*, 1844. Synops. Carb. Foss. Ireland, p. 58.
— trigonalis, *M'Coy*, 1844. Ibid., p. 59.
— giganteus, *M'Coy*, 1844. Ibid., p. 58, pl. ix, fig. 1.
— nodulosus, *M'Coy*, 1844. Ibid., p. 59, pl. ix, fig. 4.
— Hibernicus, *Morris*, 1845. Cat. Brit. Foss., 1st edit., p. 99.
— trigonalis, *Morris*, 1845. Ibid., p. 99.
Conocardium Hibernicum, *Bronn*, 1848. Nomencl. Palæontol., p. 525.
Pleurorhynchus Hibernicus, *Brown*, 1849. Illust. Foss. Conch., p. 201, pl. lxxxii, figs. 14, 15.
— trigonalis, *Brown*, 1849. Ibid., p. 202, pl. lxxxii, figs. 12 and 19.
Conocardium trigonale, *d'Orbigny*, 1851. Prod. Paléontol., p. 132.
— Hibernicum, *d'Orbigny*, 1851. Ibid., p. 132.
— giganteum, *d'Orbigny*, 1851. Ibid., p. 131.
Non — Hibernicum, *de Koninck*, 1851. Anim. Foss. Terr. Carbonif. Belg., Suppl., p. 676, pl. lvii, figs. 10*a*, *b*.
— — *Morris*, 1854. Cat. Brit. Foss., 2nd edit., p. 194.
— giganteum, *Morris*, 1854. Ibid., p. 194.
— trigonale, *Morris*, 1854. Ibid., p. 194.
— Hibernicum, *Woodward*, 1856. Manual Mollusca, p. 292, pl. xix, fig. 5.
Pleurorhynchus Hibernicus, *Griffith*, 1860. Journ. Geol. Soc. Dublin, vol. ix, p. 91.
— trigonalis, *Griffith*, 1860. Ibid., p. 91.
— giganteus, *Griffith*, 1860. Ibid., p. 91.
— Hibernicus, *Baily*, 1875. Fig. Char. Brit. Foss., vol. i, p. 115, pl. xxxix, figs. 7 *a*, *b*.
Conocardium Hibernicum, *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 303.

Conocardium giganteum, *Bigsby*, 1878. Ibid., p. 303.
— trigonale, *Bigsby*, 1878. Ibid., p. 303.
— hibernicum, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 101, pl. xviii, figs. 7, 8.
— — *Etheridge*, 1888. Brit. Foss., pt. 1, Palæozoic, p. 281.
— giganteum, *Etheridge*, 1888. Ibid., p. 281.
— trigonale, *Etheridge*, 1888. Ibid., p. 281.

Specific Characters.—Shell very inequilateral, very short antero-posteriorly, deep; of only moderate size, trigonal, horse-hoof shaped, acutely ridged, abruptly truncate, and much adpressed posteriorly. Posterior end obsolete, with an expanded cordate flattened posterior surface.

The anterior end is bluntly conical, rapidly narrowed from above downwards at the expense of its lower border, and rapidly compressed, but gaping; separated from the gibbose portion of the valve by a broad well-marked sulcus. The inferior border slopes rapidly downwards in a sinuous line, convex at each extremity, but concave in its centre, terminating abruptly at the postero-inferior angle. The hinge-line is very short, straight, continuous posteriorly with the upper margin of the long rostrum. The umbones are small, incurved, gibbose in front, but abruptly truncate behind. Passing vertically downwards from the apex of the umbo is a strong angular keel, which forms the border between the lateral and posterior surfaces. To it is attached a broad shelly expansion, which forms a flange all round the posterior surface of the shell, nearly equalling in depth that of the shell itself, and curved backwards so as to enlarge considerably the posterior surface, which is made by it much more concave, the concavity looking backwards. The posterior surface is excentrically concavo-convex; externally there is a smooth zone, slightly convex; further inwards the surface becomes concave except along the margin, which is raised and forms an elevated line from the lower margin of the rostrum to the lower angle. This raised line itself is concave, and still more internally towards the upper part of the surface becomes smooth and elevated, forming the base of the rostrum, which is tubular, of moderate diameter, and of uncertain length.

Interior.—No details have been observed in this species.

Exterior.—The surface of the shell is nearly smooth, but marked with fine concentric lines and striæ of growth, and fine radiating lines. The majority of specimens have the outer layer of shell destroyed, and show series of radiating ribs of various sizes, according to the depth of the layer; the lowest ribbed layer consists of strong, well-separated, radiating flattened ribs. On the posterior surface the concave portion is finely and excentrically ribbed. The flange is very finely striate radially. Shell thick, with several layers.

Dimensions.—Pl. LIII, fig. 10, a fairly complete specimen, measures—

Antero-posteriorly (not including the rostrum)	45 mm.
Dorso-ventrally	48 mm.
From side to side	53 mm.

Pl. LIII, fig. 8—

Dorso-ventrally	54 mm.
Depth of flange	42 mm.

Localities.—England: the Carboniferous Limestone of Withgill, Yorkshire; Clitheroe, Lancashire; Thorpe Cloud, Derbyshire. Ireland: the Carboniferous Limestone of St. Dooghlas and Malahide, co. Dublin; Rowerby, Kilmallock, and Kilgrogan, co. Limerick.

Observations.—This species was figured twice in Sowerby's 'Mineral Conchology' (*op. cit.*), the second time to show the peculiar flange in extension of the keel, and on both occasions was referred to the genus *Cardium*. The first figure is stated to be a compound one. Sowerby says, "I have had recourse to several specimens to produce the upper figure," and there is no doubt that it represents the species very well indeed; the specimens are in the Sowerby Collection at the British Museum (Nat. Hist.). Phillips's figure unfortunately cannot be taken as typical, for it is stated to be "reduced." There has been little or no misconception with regard to this species on the part of authors, with the exception that M'Coy described a crushed example as a new species, *Pleurorhynchus giganteus*, the types of which are very much distorted and too imperfect to serve as types. I have no doubt at all that the two shells figured as *Pleurorhynchus giganteus* are large examples of Sowerby's species. M'Coy states that "the contracted posterior end [is] marked with strong ridges from the beak." This observation, correct as to the specimen itself, was not understood by its author, for the ribs are seen only because the outer layer of shell has been removed—a fact that is at once evident on an examination of the type specimen, Pl. LIII, fig. 7. The other specimen figured by M'Coy, a crushed fragment, however, shows the broad shell flange attached to the angular keel.

This species is popularly known to quarrymen by the name of asses' or horses' hoofs, from the shape of the shell and the cast left from the posterior surface and its flange. The very short, deep, rapidly expanded angular shape and flattened posterior surface distinguish the shell at once from all other species. I am not aware at present of any other British species having possessed a broad shelly process or flange, but it is certainly present in the *C. subtrigonale* from the Upper Helderberg group and an American form, which are quite distinct from *C. Hibernicum*.

De Koninck, as he himself later on admitted, referred a totally different shell to *C. Hibernicum* in 1842. The name *C. Herculeum* was substituted for it in 1885 (*op. cit.*). This species, as may be seen by Pl. LI, fig. 11, has a very different form, and has no shelly expansion or flange. A small example of *C. Hibernicum* possesses the typical shape and other characters of the adult.

I am very doubtful whether *C. Hibernicum* had a rostrum of any length. I have examined several specimens which are adherent to the fringe, and where the matrix in the neighbourhood has been undisturbed, but I have been able in no case to see any indication of such a structure.

An examination of the type of Phillips's *Pleurorhynchus trigonalis* demonstrates at once that this specimen is the young of *C. Hibernicum*, and the species must therefore be placed in the list of synonyms of the latter shell. The name *C. trigonale* has, however, been given to a very peculiarly shaped shell, quite distinct from *C. Hibernicum*, and de Koninck has referred a series of shells from the Carboniferous Limestone of Belgium to this species. It is now, therefore, necessary to adopt a new name for these shells, which are at once separated from *C. Hibernicum* by the absence of the broad flattened posterior surface, by the more median angular keel, and by the very narrow and compressed anterior wing, for which I have adopted the name *C. alatum*, de Koninck.

Phillips's shell is said to have come from Bolland.

The small shell figured by M'Coy as *Pleurorhynchus nodulosus* is probably only a young example of *C. Hibernicum.* I reproduce it, Pl. LIII, fig. 6. It is very vague and not free from the matrix, and the special characters on which M'Coy founded the species are difficult to appreciate. I am inclined to regard the so-called nodules as being due to somewhat accentuated lines of growth passing over the angular margin of the valve.

CONOCARDIUM DECUSSATUM, *R. Etheridge, jun.*, 1873. Pl. LIII, figs. 1, 2, and 4.

CONOCARDIUM DECUSSATUM, *R. Etheridge, jun.*, 1873. Geol. Mag., dec. 1, vol. x, p. 297, pl. xii, fig. 5.

— — *R. Etheridge, sen.* Brit. Foss., pt. 1, Palæozoic, p. 281.

Specific Characters.—Shell almost equilateral, deep, compressed at either end, gibbose in the median or body portion, broadly U-shaped. The anterior end is compressed, short, deep, and truncate; its margin descends downwards, and only slightly backwards, and passing round into the inferior border becomes very convex, then passes upwards again, and becomes continuous with the posterior margin, forming one regular curve. The posterior end is triangular and much compressed, forming a small wing. The body of the valve is convex from before backwards, the passage from the body to the posterior flattened slope being more sudden than that from the body to the anterior part of the shell. The hinge-line is almost straight, forming by far the longest antero-posterior diameter. The umbones are obtuse, swollen, not raised, incurved, and placed almost at the centre of the hinge-line. The rostrum has a broad triangular base, continuous below with the posterior border.

Interior.—Although two of the figured specimens are casts of the interior they give no details, but apparently were more regularly concave and less angular internally.

Exterior.—Surface when well preserved almost smooth, otherwise covered with fine regular radiating ribs.

Dimensions.—Pl. LIII, fig. 4, from Law, Dalry, measures—

Antero-posteriorly (estimated) . .	12 mm.
Dorso-ventrally	7 mm.
From side to side	7 mm.

Localities.—Scotland: the Lower Limestone series of Law, and Glencourt, Dalry, Ayrshire; Potmetal plantation, Bogie, Kirkaldy.

Observations.—Mr. R. Etheridge, jun., described a new species of *Conocardium* under the name *C. decussatum*, which, I think, may possibly represent the species under discussion, though his figures and description are not at all clear, and the type specimens are not to be found. Mr. J. G. Goodchild has kindly searched for them in the Museum of the Geological Survey of Scotland, and cannot trace them. Etheridge's figures (*op. supra cit.*) show the very strong angular keel. He says, "It is a small species, of a regular horse-hoof form, with an exceedingly strong ridge separating the anterior and posterior sides, amounting almost to a keel. In general form it resembles *C. trigonale*, Phill., and some depressed varieties of *C. hibernicum*, Sow., but may be at once distinguished from both these by the shell ornamentation." I would remark that in this species, as in all others of the genus, the ornament depends on the state of preservation and on the layer of shell exposed, and that it is impossible to separate the species of *Conocardium* by the ornaments or number of ribs on the surface.

Mr. Etheridge's specimens are stated to have been obtained from the Upper Limestone series of Orchard, near Glasgow, and I regret that I have not been able to study a series of shells from this locality.

This species would seem to occupy a position midway between *C. rostratum* and *C. inflatum;* more angular than either in the body, the posterior end is not so long as that of the former species, and much less adpressed than in the latter.

CONOCARDIUM ALATUM, *de Koninck*, 1885. Plate LIII, figs. 3 and 5.

CONOCARDIUM ALATUM, *de Koninck*, 1885. Ann. Mus. Roy. Hist. Nat. Belg., vol. xi, p. 118, pl. xix, figs. 26—29.

Specific Characters.—Shell small, inequilateral, trigonal, acutely keeled. Body of the valve deep, acutely angular, rapidly compressed both in front and behind. The anterior portion forms a triangularly conical wing, separated from the body of the valve by a well-marked, somewhat oblique groove, gaping at the narrow extremity and along the lower border. The inferior margin slopes rapidly downwards and backwards till it meets the groove separating the anterior wing from the body of the valve, where it becomes suddenly bent downwards on itself till it reaches the lower part of the body, where it curves upwards to join the crest formed by the elevated vertical line of the opposing edges of the valves, which bisects the posterior surface. The hinge-line is straight and produced, and continuous behind with the upper part of the rostrum.

The umbones are acutely carinate, pointed, incurved, contiguous, hardly raised above the hinge-line, and the stump of the rostrum is present, appearing to be subcentral. From the umbo proceeds vertically to the lower margin an acute ridge, becoming broader and less angular below, which separates the lateral and posterior surfaces of the valve. The posterior surface is cordate, large, convex, with a median vertical ridge which terminates above in the base of the rostrum.

The body of the valve is rapidly compressed in front of the keel; length of rostrum unknown.

Interior.—Specimens show the characteristic details of the genus.

Exterior.—The surface is covered with radiating ribs, few and further apart on the anterior wing, closer and more regular but more curved on the posterior surface.

Dimensions.—Pl. LIII, fig. 3, a specimen from Lesmahagow, in the collection of the Geological Survey, Jermyn Street, measures—

Antero-posteriorly	15 mm.
Dorso-ventrally	12·5 mm.
From side to side	12 mm.

Localities.—England: the Carboniferous Limestone of Settle. Scotland: the Lower Limestone series of Lesmahagow and Law, Dalry, Ayrshire.

Observations.—This species is easily recognised by its peculiar shape and the absence of an adpressed and flattened posterior surface, the strong vertical keel, and the compressed, narrow, anterior wing. The specimens which have served for the above description were all labelled *C. trigonale*, and, indeed, with justice on the mere reference to the figure of this species; but, unfortunately, the type of

C. trigonale preserved in the Gilbertson Collection of the British Museum, Pl. LII, fig. 3, is without any doubt the young of *C. hibernicum.*

De Koninck figured this characteristically shaped shell under the name *C. alatum*, and his type appears to have been about the same size as that in the Woodwardian Museum, Pl. LIII, fig. 5. De Koninck states that this species possesses a little tubercle placed between the umbones, a character which he has observed in no other species of the genus. This tubercle is well seen in Pl. LIII, fig. 5 *a*. Hall has observed a similar character in the American *C. catastomum.*

Genus CHÆNOCARDIOLA, *Holzapfel*, 1889, emend. *Beushausen*, 1895.

LUNULACARDIUM, *Baily*, 1860. Expl. Sheet 142, Geol. Surv. Ireland, p. 19.
— *Holzapfel*, 1882. Goniatitenkalk von Adorf, Palæontographica, vol. xxviii, p. 255.
LUNULOCARDIUM (pars), *Hall*, 1885. Geol. Surv. New York, Pal., vol. v, pts. i, ii, p. 437.
CONOCARDIUM (pars), *Etheridge*, 1888. Brit. Foss., pt. i, Palæozoic, p. 281.
LUNULICARDIUM, *Miller*, 1889. North American Geol. and Palæontol., p. 486.
CHÆNOCARDIOLA, *Holzapfel*, 1889. Kalte von Erdbach-Breitscheid, Pal. Abh. Dames and Kayser, vol. i.
— *Beushausen*, 1895. Abhand. Königl. Preuss. Geol. Landesanstalt, p. 364.

Generic Characters.—Shell equivalve, inequilateral, triangular, oblique, truncate behind. Border rounded in front and below, obliquely truncate behind. Umbones pointed, inrolled, and twisted forwards. Lunule (?) large. Shell moderately swollen in front, with a sudden angular ridge from the umbo to the postero-inferior angle and a rapidly compressed dorsal slope.

Interior.—Anterior adductor muscle-scar small, round, deep, placed just below and in front of the umbo, overshadowed by a thickened hinge-plate. Posterior scar not known. Pallial line simple.

Hinge thickened in front, probably with teeth, with parallel striations posteriorly.

Interior marked with radiating ribs near the margin, with a smaller shorter rib between each.

Exterior.—The surface is ornamented with radiating ribs.

Observations.—Beushausen has seen fit to amend and limit the genus *Lunulicardium*, Münster, and to remove certain shells from *Lunulicardium* to a new genus, *Chænocardiola* (*op. supra cit.*), which I propose to adopt, as the characters of the interior revealed by Baily's types are not those of the former genus. At the same time I do not agree with Beushausen's orientation of the shell, and have no doubt that the short, obliquely truncate end is posterior. Under these circumstances Beushausen's description will need revision. I am not at all clear as to the real affinities of *Chænocardiola*, though there is a certain resemblance to *Conocardium*, and further material is necessary for study before any more definite statement can be made. I am, however, of opinion that the genus is more nearly related to the *Cardiidæ*. One species occurs in British Carboniferous rocks, in the Coal Measures both of Ireland and England, and as far as I can ascertain at present at a single horizon in each country.

Beushausen states that the genus *Chænocardiola* occurs first in Upper Silurian rocks, and exists in the Middle and Upper Devonian; it would now appear that it did not die out till Coal Measure times.

CHÆNOCARDIOLA FOOTII, *Baily*, sp., 1860. Plate LII, figs. 5—7.

LUNULACARDIUM FOOTII, *Baily*, 1860. Expl. Sheet 142, Geol. Surv. Ireland, p. 19, fig. 9 *a*—*e*.
CONOCARDIUM FOOTII, *Etheridge*, 1888. Brit. Foss., pt. i, Palæozoic, p. 281.

Specific Characters.—Shell of moderate size, oblique, triangularly semilunate, slightly convex, truncate behind. The anterior end is comparatively large, and projects in front of the umbo, compressed at margin, rounded, continuous with the curved inferior border, which is bent rapidly upwards at its posterior extremity to join the straight, oblique, posterior border at a well-marked angle. The hinge-line is short and curved, especially in front.

The umbones are small, pointed, incurved, and twisted forwards, elevated above the valve. Passing downwards and backwards from the umbones to the postero-inferior angle is a well-marked ridge, behind which the valve is rapidly compressed, forming a narrow but long and oblique dorsal slope. In front of the oblique ridge the valve is regularly but gently curved.

Interior.—I have described the internal characters of the genus from this species, and need not repeat the description here.

Exterior.—The surface is covered by concentric lines and ridges of growth, which are crossed by well-marked, strong, not numerous, radiating ribs. At the margin where the concentric lines are stronger, the ribs have well-marked crenulations, but these are not so distinct above.

Dimensions.—Pl. LII, fig. 5 *b*, one of the types of Baily's species, measures—

Antero-posteriorly	26 mm.
Dorso-ventrally	24 mm.

Localities.—England: Coal Measures, Burnley, Lancashire. Ireland: Coal

Measures, Rosscliff, co. Clare; South Bank, river Boyne, Drogheda; Westown, co. Dublin.

Observations.—This species was founded by Mr. Baily on a series of specimens from Rosscliff, co. Clare, and he gave five figures of his shells in the explanation of sheet No. 142, *op. supra cit.* Most of these specimens are casts of the interior, but a few casts of the exterior are also present. It is probable that these have been crushed, and that the true contour of the valve is not seen, especially the posterior end. Two specimens of *C. Footii* are in the Manchester Museum, Owens College, in the Kay-Shuttleworth Collection, from the Burnley Coal-field, but the actual horizon is not quoted, and the specimens are by no means good ones. I have not met with the species in any other locality in England. Pl. LII, fig. 6, shows certain portions of the hinge-plate as a cast. The plate was evidently much thickened in front, and there are depressions and elevations on it indicating the presence of hinge-teeth, but, unfortunately, they are too indistinct for description. Posteriorly to the umbones the plate is seen, Pl. LII, fig. 5 *a*, to have parallel striations for some little distance along the extreme upper edge, but this part seems to have been remote from that of the opposite valve, because casts show a much deeper groove below the striated portion which corresponded to the actual opposing edge of the hinge. It is possible, therefore, that the striations point to the insertion of the posterior ligament, the more so for the striations are limited only to the upper portion.

I would point out that Beushausen figures an analogous character in *Lunulicardium ventricosum* (*op. supra cit.*, pl. xxvii, fig. 3), but he does not seem to have been fortunate enough to observe the interior of any of the species which he referred to *Chænocardiola.*

PLATE XL.

Fig. 1.—*Sanguinolites angustatus.* The type of Phillips' ***Sanguinolaria angustata.*** In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 366.)

Fig. 2.—*Sanguinolites angustatus.* The type of M'Coy's ***S. discors.*** Preserved in the Griffith Collection, Museum of Science and Art, Dublin. (Page 366.)

Fig. 3.—*Sanguinolites angustatus.* A cast of the interior of the right valve. From Poolvash, Isle of Man. My Collection. (Page 366.)

Fig. 4.—*Sanguinolites angustatus.* A specimen from the Carboniferous Limestone of Thorpe Cloud, Derbyshire. My Collection. (Page 366.)

Fig. 5.—*Sanguinolites angustatus.* A fine testiferous example. From the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 366.)

Fig. 6.—*Sanguinolites angustatus.* A left valve. From the Lower Limestone series of Kerrsland Glen, Ayrshire. In the Collection of Mr. R. Craig. (Page 366.)

Fig. 7.—*Sanguinolites clavatus.* The type of R. Etheridge's ***Leptodomus clavatus.*** From Woodhall, Water of Leith. In the Collection of the Geological Survey of Scotland. (Page 385.)

Figs. 8, 9, 10.—*Sanguinolites clavatus.* A series of specimens. From the Calciferous Sandstone series, West of Pittenweem, Fife. Figs. 8 and 10 somewhat incomplete, Fig. 10 *a* showing the lunule and escutcheon. My Collection. (Page 385.)

Fig. 11.—*Sanguinolites clavatus.* A full-grown right valve. Same locality. My Collection. (Page 385.)

Figs. 12, 13.—*Sanguinolites clavatus.* Two specimens. From the Redesdale Ironstone beds, Northumberland. My Collection. (Page 385.)

Fig. 14.—*Sanguinolites clavatus.* A left valve from the Calciferous Sandstone series of Woodhall, Water of Leith. My Collection. (Page 385.)

Fig. 15.—*Sanguinolites argutus.* The type specimen of Phillips's ***Sanguinolaria arguta.*** In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 368.)

Fig. 16.—*Sanguinolites argutus.* The posterior two thirds of the left valve. From the Carboniferous Limestone of Thorpe Cloud, Derbyshire. My Collection. (Page 368.)

Fig. 17.—*Sanguinolites Omalianus.* A somewhat crushed example. From the Lower Limestone series of High Blantyre. In the Collection of Mr. J. Neilson. (Page 372.)

Figs. 18, 19, 20.—*Sanguinolites Omalianus.* Three specimens. From the Carboniferous Limestone of Thorpe Cloud, Derbyshire. To show different stages of growth. My Collection. (Page 372.)

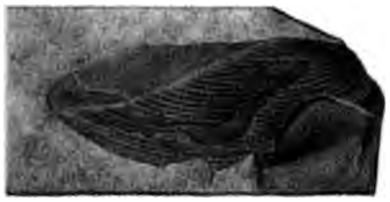
Fig. 21.—*Sanguinolites Omalianus.* A full-grown example. From the Carboniferous Limestone of Tomdeely, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 372.)

Fig. 22.—*Sanguinolites Omalianus.* A right valve, partly testiferous. Same locality and Collection. (Page 372.)

Fig. 23.—*Sanguinolites Omalianus.* Probably the type figured by Baily as ***Myacites Omalianus.*** From Lisbane, co. Limerick. Same Collection. (Page 372.)

Fig. 24.—*Sanguinolites Omalianus.* A specimen from High Blantyre, showing Fig. 24 *a*, the escutcheon and lunule. In the Collection of Mr. J. Neilson. (Page 372.)

PLATE XL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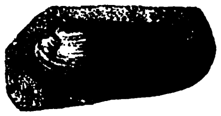
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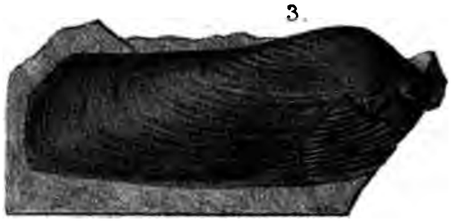
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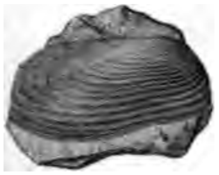
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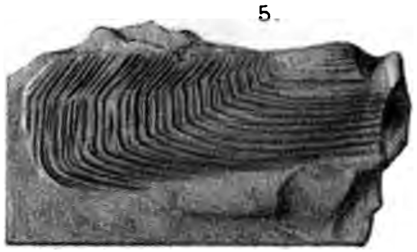
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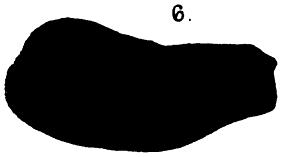
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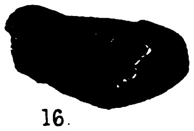
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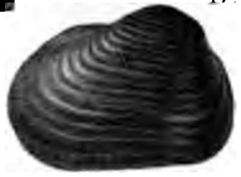
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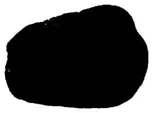
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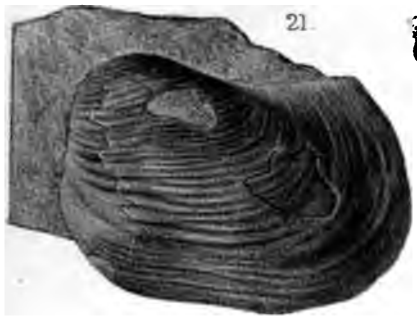
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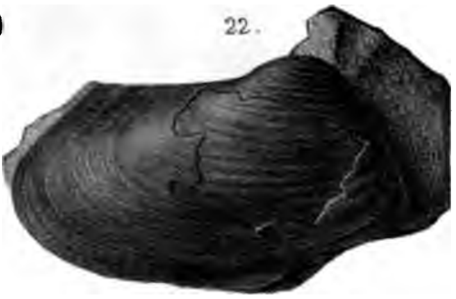
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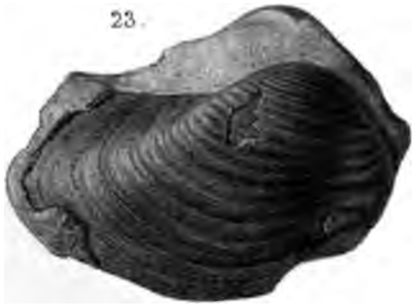
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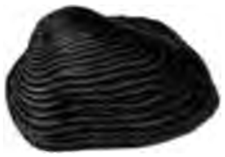
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J Searle del. et lith.

Mintern Bros

PLATE XLI.

Fig. 1.—*Sanguinolites hibernicus*. A left valve from Cavedale, Castleton. My Collection. (Page 375.)

Fig. 2.—*Sanguinolites hibernicus*. A cast of the interior. From the Carboniferous Limestone of Ballymark, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 375.)

Fig. 3.—*Sanguinolites hibernicus*. A testiferous example of the left valve. Same locality and Collection. (Page 375.)

Fig. 4.—*Sanguinolites hibernicus*. A right valve with large portion of the test preserved. Fig. 4 *a*, giving a view of the lunule and escutcheon. Same locality and Collection. (Page 375.)

Fig. 5.—*Sanguinolites Walciodorensis*. A left valve. From the Carboniferous Limestone of Doohybeg, co. Limerick. Same Collection. (Page 376.)

Fig. 6.—*Sanguinolites Walciodorensis*. A right valve. Same locality and Collection. (Page 376.)

Fig. 7.—*Sanguinolites Walciodorensis*. A full-grown shell, incomplete in front. From the Carboniferous Limestone of Ballygarrane, co. Limerick. Same Collection. (Page 376.)

Fig. 8.—*Sanguinolites costellatus*. An adult example, almost perfect. From the Gurdy railway cutting. My Collection. (Page 377.)

Fig. 8 *a*.—*Sanguinolites costellatus*. The same shell viewed from above, showing the lunule, escutcheon, and sculpture of the dorsal slope.

Fig. 9.—*Sanguinolites costellatus*. A smaller example, showing Fig. 9 *a*, the expanded and pressed anterior end and lunule. Same locality. My Collection. (Page 377.)

Fig. 10.—*Sanguinolites costellatus*. A medium sized specimen. Same locality. My Collection. (Page 377.)

PLATE XLI.

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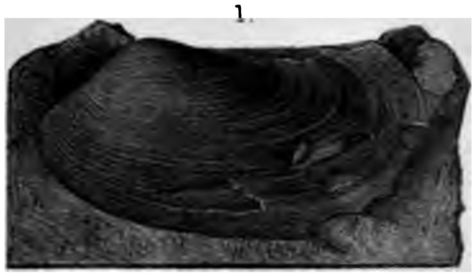

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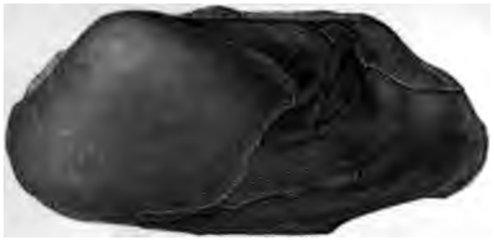

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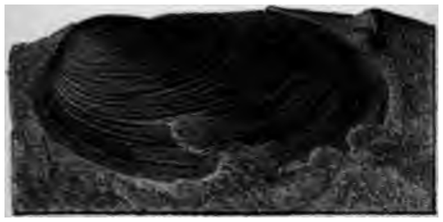

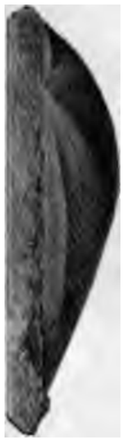

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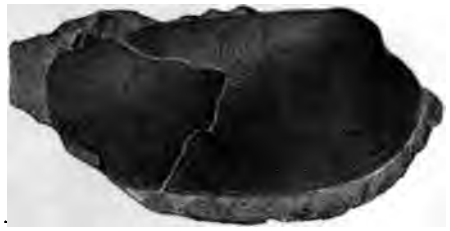

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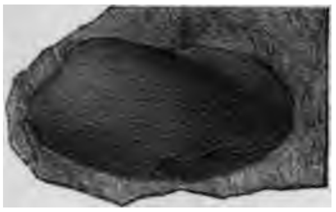

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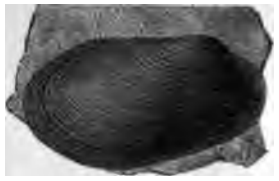

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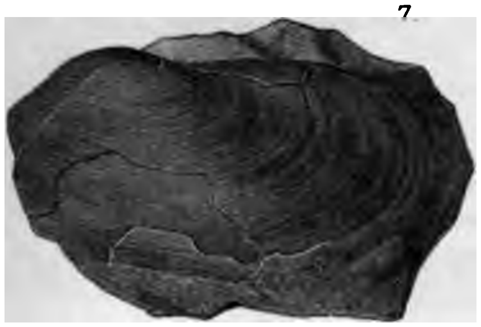

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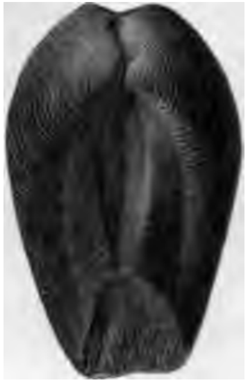

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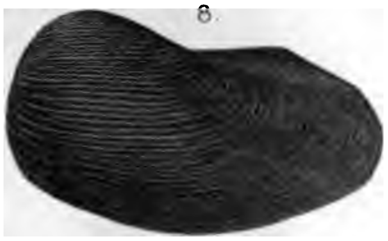

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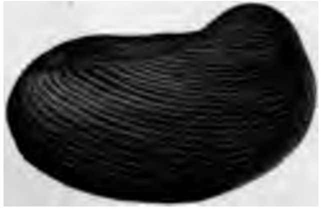

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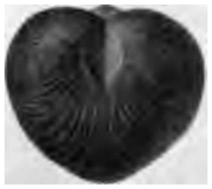

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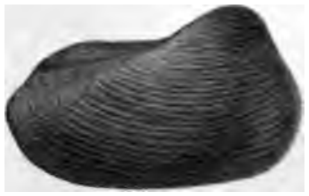

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PLATE XLII.

Fig. 1.—*Sanguinolites angulatus.* A right valve. From the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 371.)

Fig. 2.—*Sanguinolites angulatus.* The left valve of a young specimen. Same locality and Collection. (Page 371.)

Figs. 3, 4.—*Sanguinolites angulatus.* Two right valves showing 4 *a*, the umbones and long escutcheon. Same locality and Collection. (Page 371.)

Fig. 5.—*Sanguinolites* V-*scriptus.* A specimen from the Redesdale Ironstone, showing 5 *a*, the upper border, My Collection. (Page 382.)

Fig. 6.—*Sanguinolites* V-*scriptus.* A crushed example, showing fig. 6 *a*, the umbones and escutcheon. From a marine band below the third Millstone Grit, Congleton Edge. My Collection. (Page 382.)

Figs. 7, 7 *a*.—*Sanguinolites* V-*scriptus.* Showing right and left valves, with the peculiar markings of the shell. Same locality. My Collection. (Page 382.)

Fig. 8.—*Sanguinolites interruptus.* A specimen from the Carboniferous Limestone of Thorpe Cloud. My Collection. (Page 383.)

Fig. 9.—*Sanguinolites interruptus.* A right valve. Same locality. In the Collection of Mr. W. F. Holroyd, of Manchester. (Page 383.)

Fig. 10.—*Sanguinolites interruptus.* A very well-marked example of a left valve. Same locality. My Collection. (Page 383.)

Fig. 11.—*Sanguinolites tricostatus.* A left valve, with portions of the shell. From Fermanagh. In the Collection of the Geological Survey of Ireland. (Page 391.)

Fig. 12.—*Sanguinolites tricostatus.* A specimen showing the posterior adductor muscle scar and the depression above it. From the Redesdale Ironstone beds. My Collection. (Page 391.)

Fig. 13.—*Sanguinolites tricostatus.* A young example. From the marine bed below the Kinder Scout Grits of Horsebridge Clough. In the Collection of Owens College, Manchester Museum. (Page 391.)

Fig. 14.—*Sanguinolites tricostatus.* A cast of the interior of the right valve. From Fermanagh. In the Collection of the Geological Survey of Ireland. (Page 391.)

Fig. 15.—*Sanguinolites tricostatus.* The right valve of Portlock's type. Preserved in the Museum of the Royal School of Mines, Jermyn Street. (Page 391.)

Fig. 16.—*Sanguinolites striato-granulosus.* A fine specimen. From Hill Stebden, Yorkshire. My Collection. With fig. 16 *a*, a view from above. (Page 393.)

Fig. 17.—*Sanguinolites striato-granulosus.* A cast of the interior. From the Carboniferous Limestone of Poolvash, Isle of Man. My Collection. (Page 393.)

Fig. 18.—*Sanguinolites striato-granulosus.* A large example. Same locality and Collection. (Page 393.)

Fig. 19.—*Sanguinolites striato-granulosus.* A specimen from Malahide, co. Dublin. In the Collection of the Geological Survey of Ireland. (Page 393.)

Fig. 20.—*Sanguinolites striato-granulosus.* A fine testiferous example. From the Lower Limestone series of Craigenglen. In the Collection of Mr. J. Neilson; with a magnified view of the surface, fig. 20 *a*. (Page 393.)

Fig. 21.—*Sanguinolites striato-granulosus.* A cast. From the Redesdale Ironstone beds. My Collection. (Page 393.)

Fig. 22.—*Sanguinolites striato-granulosus.* A cast, showing muscle scars and pallial line. From Poolvash, Isle of Man. My Collection. (Page 393.)

PLATE XLII.

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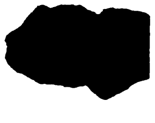

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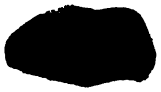

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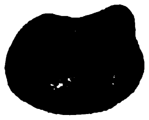

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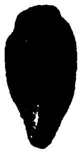

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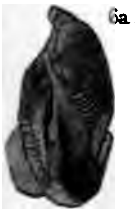

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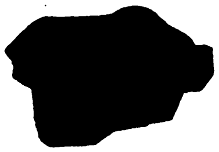

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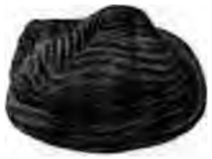

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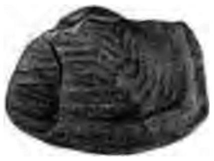

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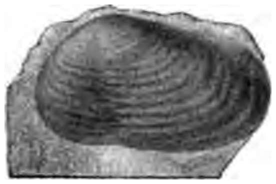

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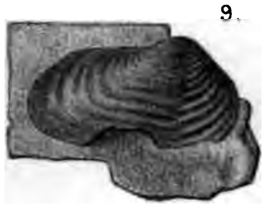

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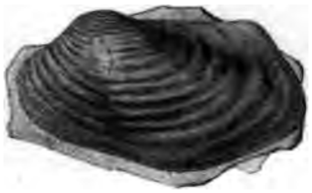

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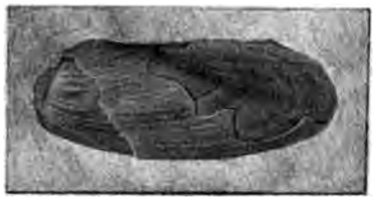

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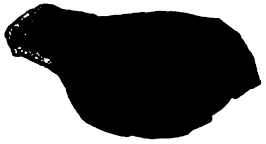

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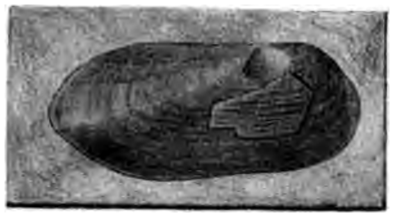

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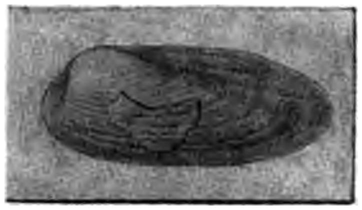

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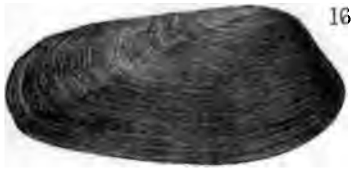

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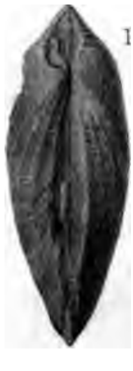

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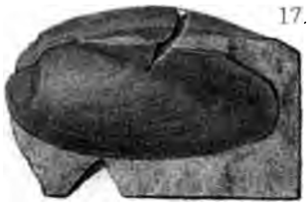

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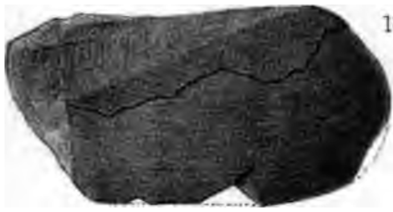

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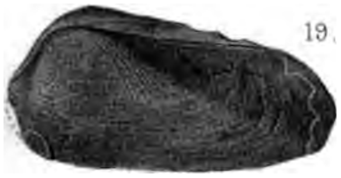

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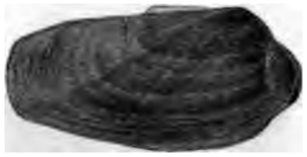

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I. Searle del. et lith.

Mintern Bro.

PLATE XLIII.

Fig. 1.—*Sanguinolites visetensis.* A fairly perfect specimen from Lowick, in the Woodwardian Museum, Cambridge. Fig. 1 *a*, the same shell viewed from above. (Page 395.)

Fig. 2.—*Sanguinolites visetensis.* A left valve possessing only half its shell, from Poolvash, Isle of Man. My Collection. (Page 395.)

Fig. 3.—*Sanguinolites visetensis.* A rather crushed specimen from the Redesdale Ironstone, Bellingham. My Collection. (Page 395.)

Fig. 4.—*Sanguinolites visetensis.* A left valve from Lowick. In the Woodwardian Museum, Cambridge. (Page 395.)

Fig. 5.—*Sanguinolites striato-lamellosus.* The cast of a left valve, from Poolvash, Isle of Man. My Collection. (Page 398.)

Fig. 6.—*Sanguinolites oblongus.* A fine specimen from the Carboniferous Limestone of Yorkshire. In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 396.)

Fig. 7.—*Sanguinolites oblongus.* A full-grown example from the Carboniferous Limestone of Park Hill. In the Collection of the Geological Survey, Jermyn Street. (Page 396.)

Fig. 8.—*Sanguinolites striato-lamellosus.* A fine specimen from Castleton, Derbyshire, showing anterior adductor muscle scar and pallial line. My Collection. (Page 398.)

Fig. 9.—*Sanguinolites striato-lamellosus.* A medium sized specimen. Same locality and Collection. (Page 398.)

Fig. 10.—*Sanguinolites striato-lamellosus.* An example from the Middle White Limestone of Craig-fawr, North Wales. In the Collection of Mr. Morton. (Page 398.)

Fig. 11.—*Sanguinolites striato-lamellosus.* An almost perfect medium sized specimen from the Carboniferous Limestone of Hill Stebden, Yorkshire, with Fig. 11 *a*, a view from above. My Collection. (Page 398.)

PLATE XLIII.

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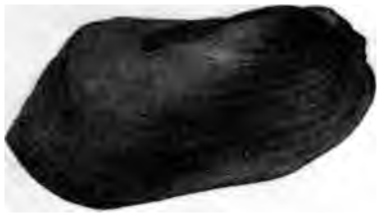

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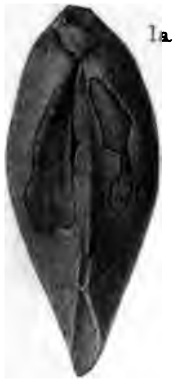

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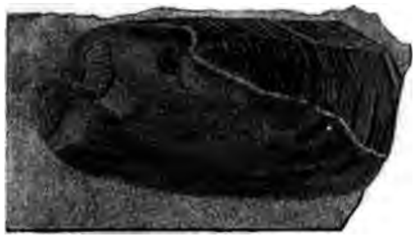

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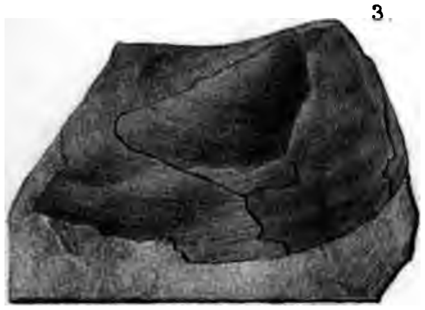

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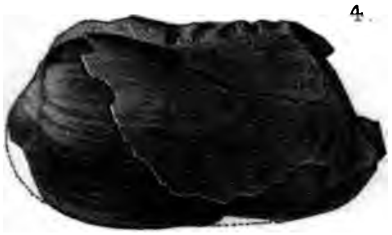

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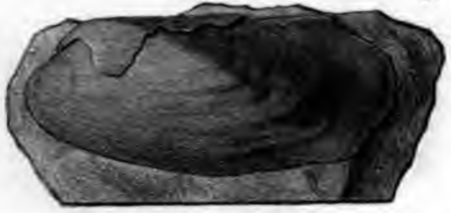

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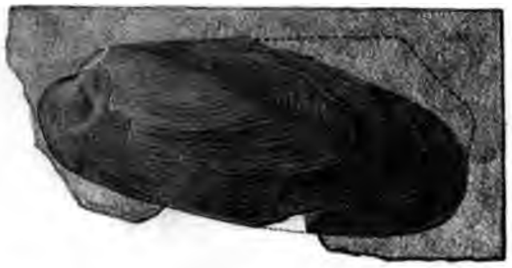

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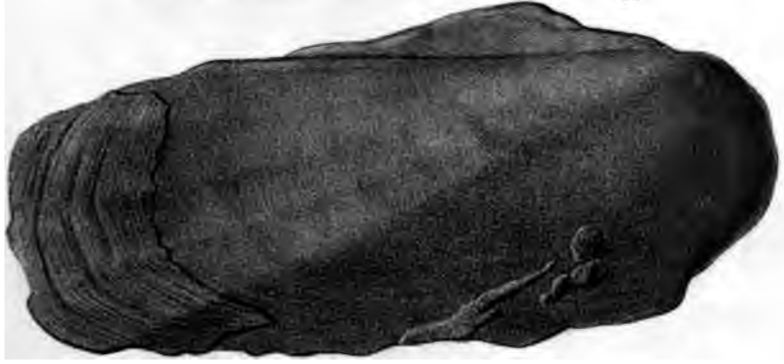

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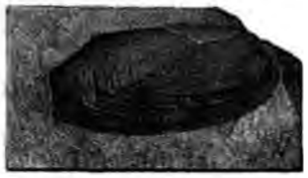

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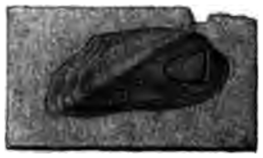

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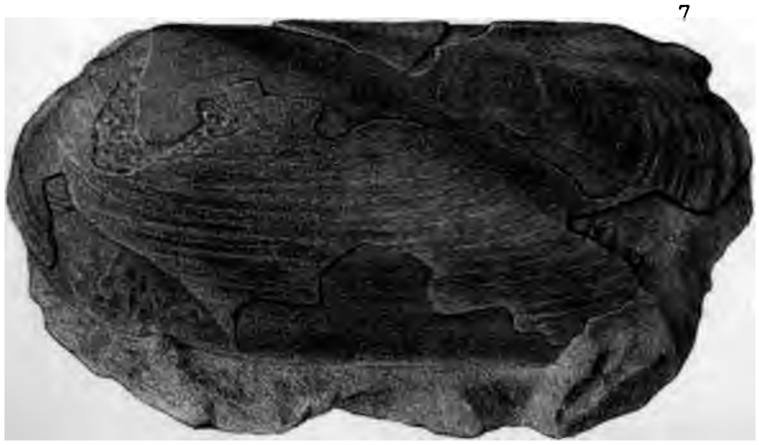

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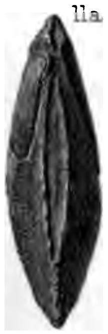

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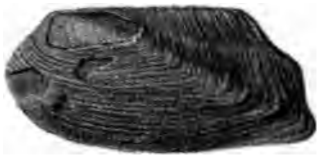

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PLATE XLIV.

Fig. 1.—*Sanguinolites variabilis.* The type of the ovate variety, figured by M'Coy, from the Carboniferous Limestone of Lowick. In the Woodwardian Museum, Cambridge. (Page 379.)

Fig. 2.—*Allorisma variabilis.* The type of M'Coy's *Sanguinolites variabilis.* Same locality and Collection. (Page 424.)

Fig. 3.—*Sanguinolites variabilis.* A nearly perfect example from the Redesdale Ironstone. My Collection. (Page 379.)

Fig. 4.—*Sanguinolites variabilis.* The anterior portion of a well-marked specimen, showing, Fig. 4 *a*, a view of the lunule, umbones, and escutcheon. Same locality and Collection. (Page 379.)

Fig. 5.—*Sanguinolites variabilis.* A young example. Same locality and Collection. (Page 379.)

Fig. 6.—*Sanguinolites variabilis.* A medium-sized shell. Same locality and Collection. (Page 379.)

Fig. 7.—*Sanguinolites variabilis.* A shell with a very distinctly marked surface ornament. Same locality and Collection. (Page 379.)

Fig. 8.—*Sanguinolites variabilis.* A specimen showing a portion of the hinge-plate. Same locality and Collection. (Page 379.)

Fig. 9.—*Sanguinolites plicatus.* The type of M'Coy's *S. plicatus* preserved in the Griffith Collection, Museum of Science and Art, Dublin. (Page 387.)

Fig. 10.—*Solenopsis parallela.* A cast from Lowick, in the Woodwardian Museum, Cambridge. (Page 415.)

Fig. 11.—*Sanguinolites plicatus.* The type of Portlock's *S. plicata.* Preserved in the Collection of the Geological Survey, Jermyn Street. (Page 387.)

Fig. 12.—*Sanguinolites plicatus.* A testiferous example (specimen No. 7 referred to by Portlock under *Sanguinolaria transversa*, from shale, co. Fermanagh) in which the fine concentric striæ are more marked than the secondary folds and grooves. In the Collection of the Geological Survey, Jermyn Street. (Page 387.)

Figs. 13, 14.—*Sanguinolites plicatus.* Two medium-sized examples from the Carboniferous Limestone of Lowick, in the Woodwardian Museum, Cambridge. (Page 387.)

Fig. 15.—*Sanguinolites plicatus.* A fragment from the Upper Limestone series of Orchard, near Glasgow, showing the exaggerated markings which Portlock considered of specific value, exactly like his figure of *S. undata.* My Collection. (Page 387.)

PLATE XLIV.

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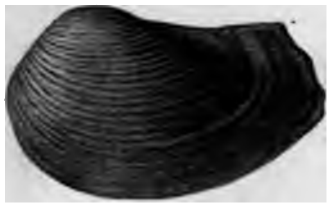

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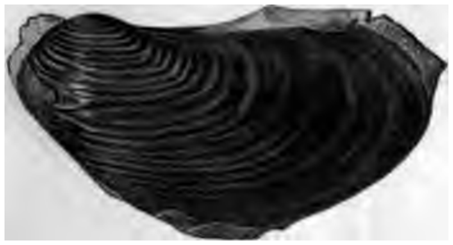

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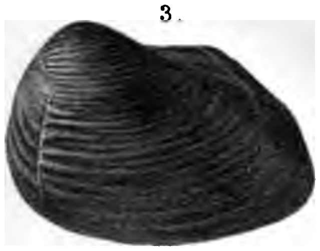

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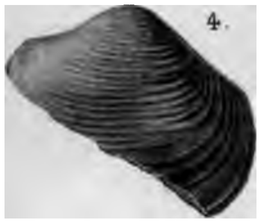

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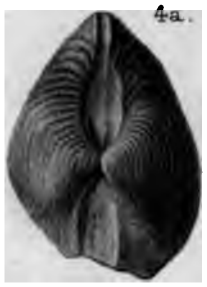

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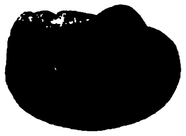

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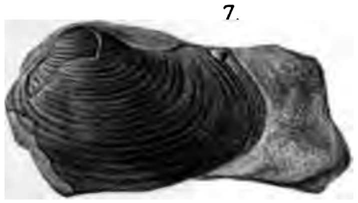

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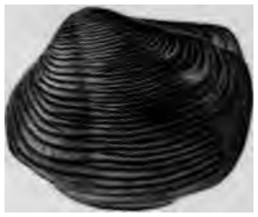

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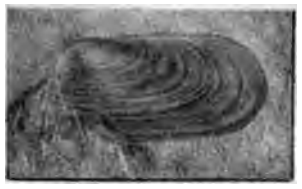

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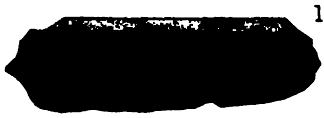

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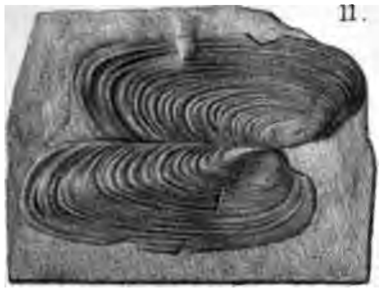

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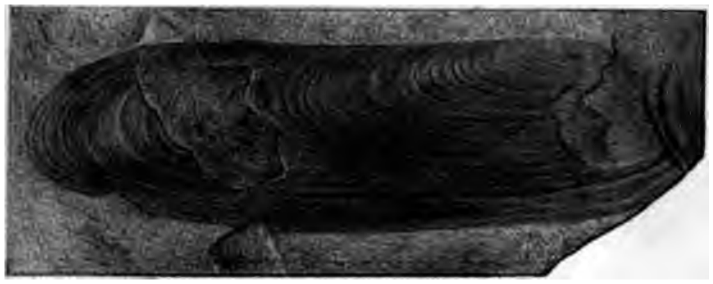

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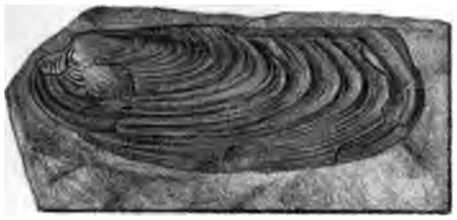

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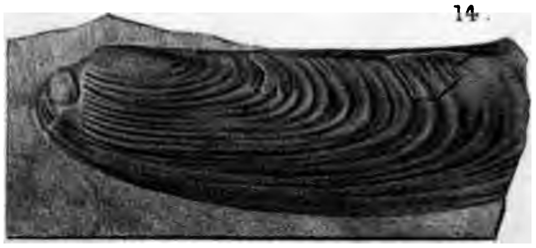

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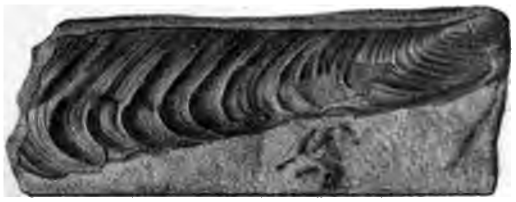

L.H. Searle del. et lith.

Mintern Bros. imp.

PLATE XLV.

Fig. 1.—*Sanguinolites plicatus.* The original of Portlock's *Sanguinolaria transversa*, a specimen with somewhat less prominent and more finely striated ribs than usual, chiefly a cast of the interior, from a bed of smooth calcareous grit, Fermanagh, preserved in the Museum of the Geological Survey, Jermyn Street. (Page 387.)

Fig. 2.—*Sanguinolites plicatus.* Showing the anterior adductor muscle-scars and a portion of the test, from the Carboniferous Limestone of Lowick. In the Woodwardian Museum, Cambridge. (Page 387.)

Fig. 3.—*Sanguinolites plicatus.* The cast of a right valve of an adult specimen. Same locality and Collection. (Page 387.)

Fig. 4.—*Sanguinolites plicatus.* The cast of a left valve, showing the details of the interior. Same locality and Collection. (Page 387.)

PLATE XLV.

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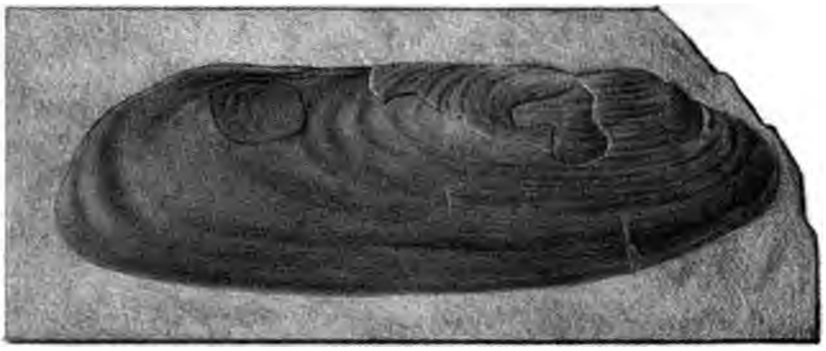

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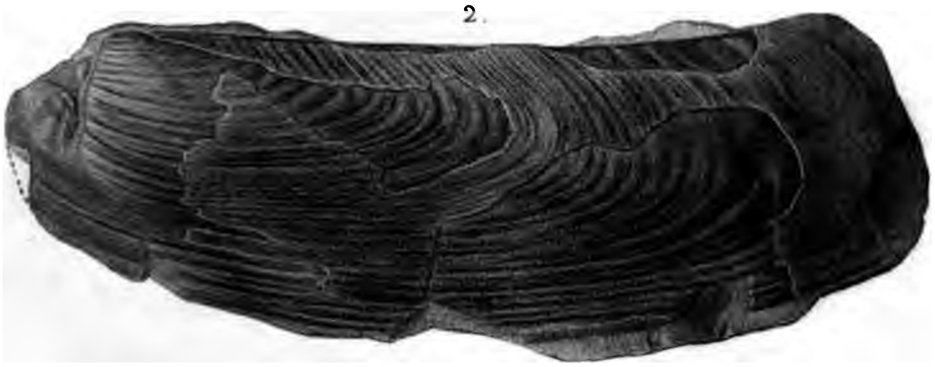

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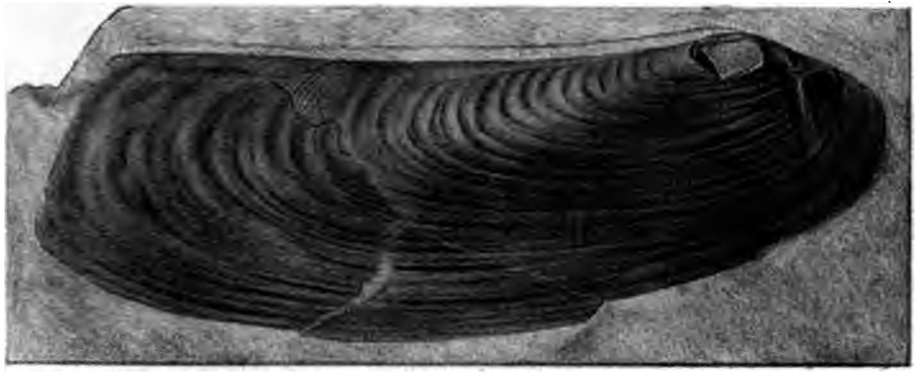

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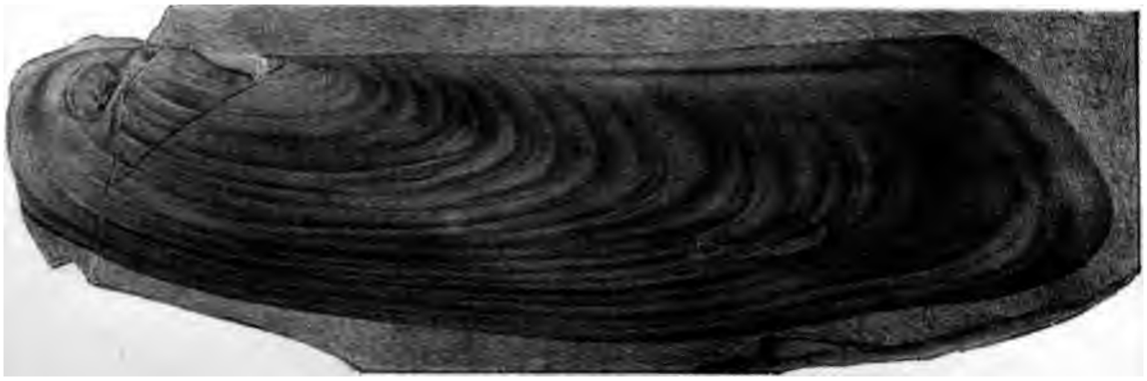

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PLATE XLVI.

Fig. 1.—*Sanguinolites striatus.* A cast of both valves. From Knockhill Quarry, Fife. In the Collection of the Geological Survey of Scotland. (Page 401.)

Fig. 2.—*Sanguinolites striatus.* A specimen of both valves, full-grown, with the test preserved. From Skolieburn, Fife. Same Collection. (Page 401.)

Fig. 3.—*Sanguinolites luxurians.* An almost perfect specimen. In the Leckenby Collection, Woodwardian Museum, Cambridge. (Page 402.)

Fig. 4.—*Sanguinolites luxurians.* A left valve. From the Carboniferous Limestone of Lisbane, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 402.)

Fig. 5.—*Sanguinolites luxurians.* A cast of the left valve. From the Limestone of Ardfodien, co. Kildare. Same Collection. (Page 402.)

Fig. 6.—*Sanguinolites abdenensis.* A right valve showing normal convexity. From Corrieburn, Kilsyth. In the Collection of the Geological Survey of Scotland. (Page 408.)

Fig. 7.—*Sanguinolites abdenensis.* A left valve. From Corrieburn, near Kilsyth, incomplete posteriorly. Same Collection. (Page 408.)

Fig. 8.—*Sanguinolites abdenensis.* A right valve. From Abden. Same Collection. (Page 408.)

Fig. 9.—*Sanguinolites abdenensis.* A left valve. Same locality and Collection • (Page 408.)

Fig. 10.—*Sanguinolites abdenensis.* A left valve. (The type specimen figured by R. Etheridge, jun.) Same locality and Collection. (Page 408.)

Fig. 11.—*Sanguinolites abdenensis.* A right valve. From Larriston burn, Roxburghshire. Same Collection. (Page 408.)

Fig. 12.—*Sanguinolites roxburgensis.* A right valve. From Blackburn, New Castleton, Roxburghshire. In the Collection of the Manchester Museum, Owens College. (Page 406.)

Fig. 13.—*Sanguinolites roxburgensis.* A right valve. Same slab. Same Collection. (Page 406.)

Fig. 14.—*Sanguinolites ovalis.* A cast of the interior of the left valve. From Holt Head. My Collection. (Page 411.)

Fig. 15.—*Sanguinolites ovalis.* A rather crushed right valve. Same locality and Collection. (Page 411.)

Fig. 16.— *Sanguinolites ovalis.* The cast of the anterior end of the left valve, showing the anterior adductor muscle-scar. Same locality and Collection. (Page 411.)

Fig. 17.—*Sanguinolites ovalis.* An almost complete example of the right valve with the test preserved. Same locality and Collection. (Page 411.)

PLATE XLVI.

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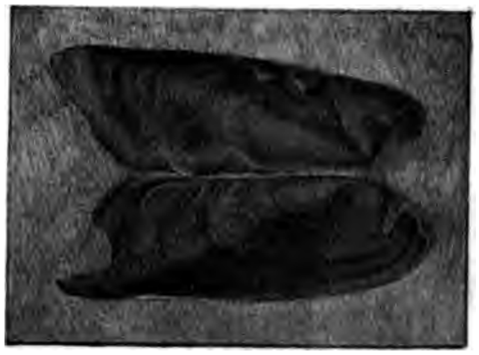

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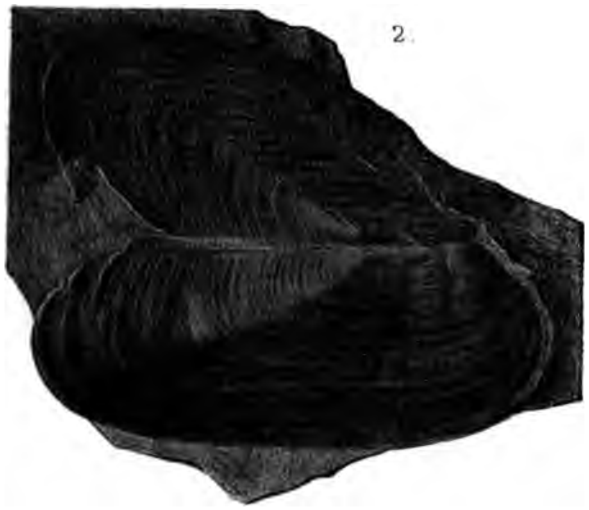

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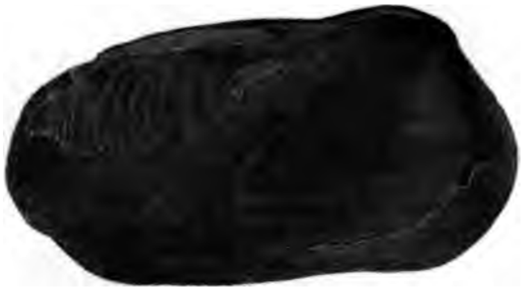

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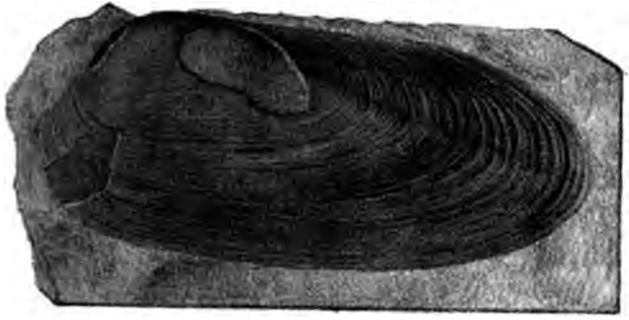

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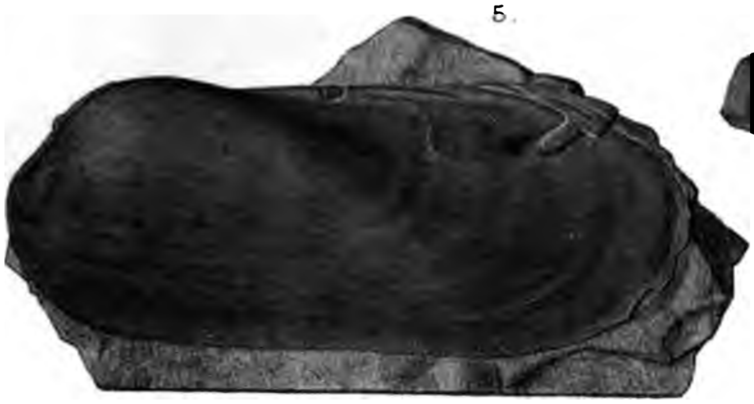

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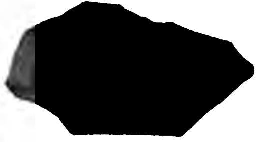

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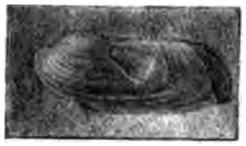

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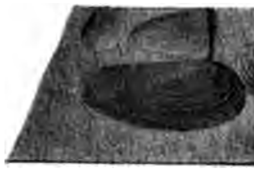

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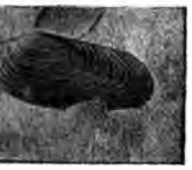

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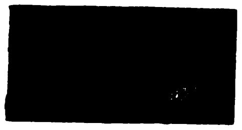

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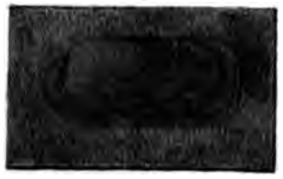

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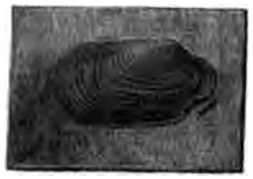

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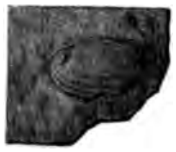

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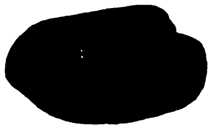

A.H.Searle del.et lith.

Mintern Bros. imp.

PLATE XLVII.

Fig. 1.—*Sanguinolites subcarinatus.* A left valve (M'Coy's type). From the Carboniferous Limestone of Lowick. In the Collection of the Woodwardian Museum, Cambridge. (Page 409.)

Fig. 2.—*Sanguinolites subcarinatus.* A specimen, left valve. From the Carboniferous Limestone of Poolvash, Isle of Man. My Collection. (Page 409.)

Fig. 3.—*Sanguinolites subcarinatus.* A full-grown left valve. From the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 409.)

Fig. 3 *a.*—*Sanguinolites subcarinatus.* The same specimen viewed from above.

Fig. 4.—*Sanguinolites subcarinatus.* A right valve. From Poolvash, Isle of Man. My Collection. (Page 409.)

Fig. 5.—*Allorisma maxima.* The type of Portlock's *Sanguinolaria maxima.* From Donaghenry, co. Tyrone. In the Collection of the Geological Survey, Jermyn Street. (Page 419.)

Fig. 6.—*Allorisma maxima.* An almost perfect specimen, showing the sinuated pallial line and muscle-scars. From the Carboniferous Limestone near Llangollen, North Wales. (Page 419.)

Fig. 7.—*Allorisma maxima.* A very fine example of a cast of the interior. From the same locality, in the possession of Mr. J. G. Goodchild, F.G.S. (Page 419.)

Fig. 7 *a.*—*Allorisma maxima.* The same specimen viewed from above. (Page 419.)

PLATE XLVII.

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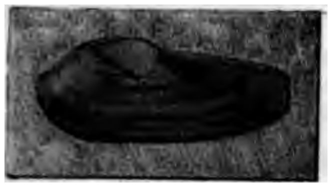

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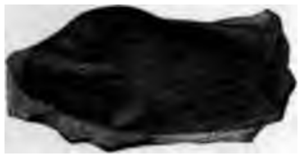

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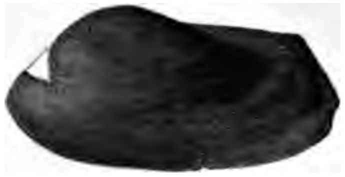

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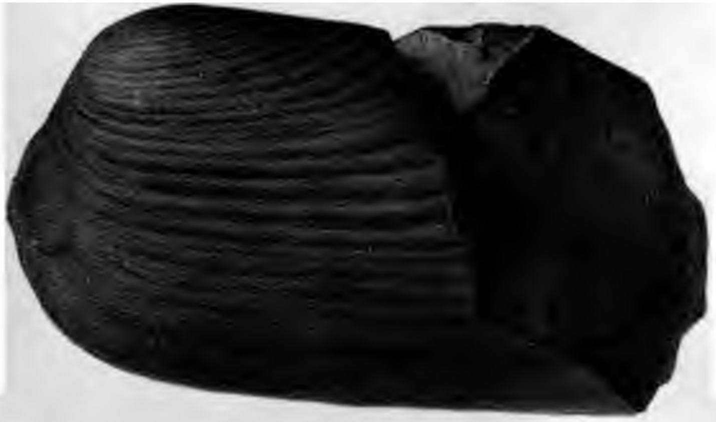

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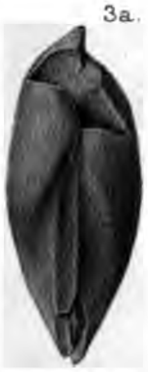

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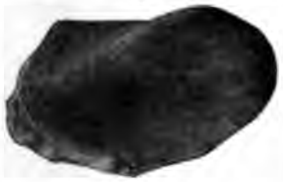

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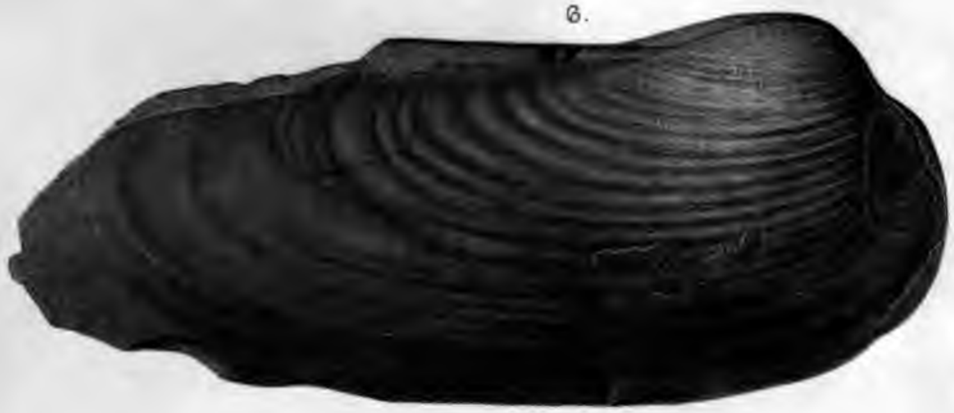

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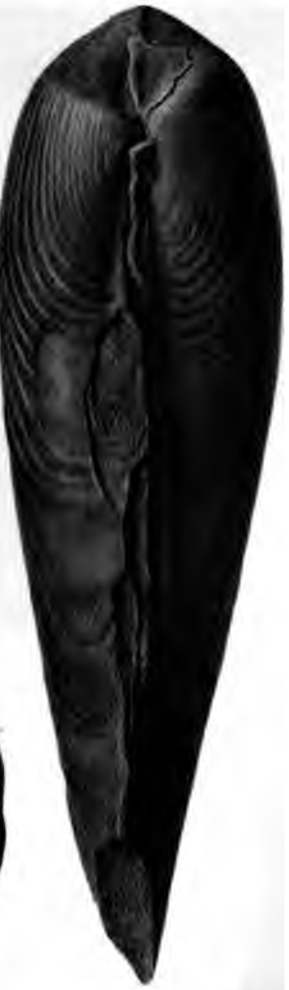

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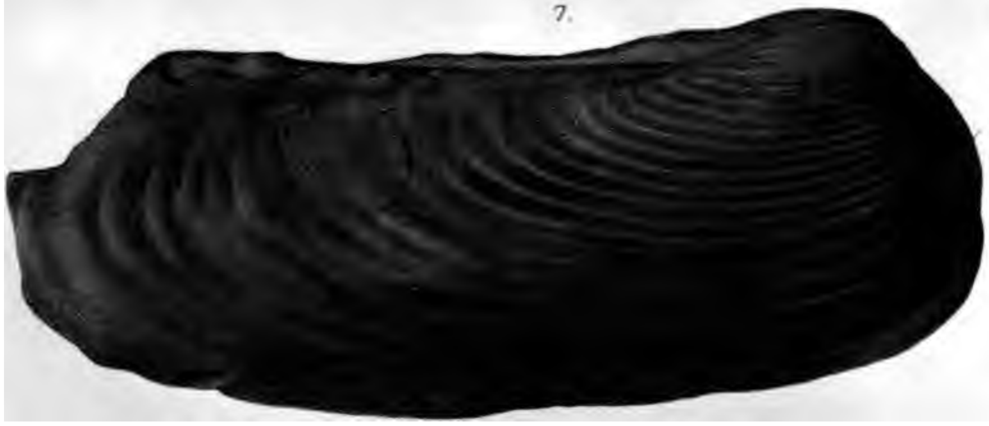

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PLATE XLVIII.

Fig. 1.—*Allorisma variabilis.* A specimen from the Calderwood Limestone, Kirktonholm, East Kilbride, showing the pallial sinus. In the Collection of Mr. J. Neilson. (Page 424.)

Fig. 2.—*Allorisma variabilis.* Another example. Same locality and Collection. (Page 424.)

Figs. 3, 4.—*Allorisma sulcata.* Two specimens from the Redesdale Ironstone beds, showing sinuated pallial line. My Collection. (Page 422.)

Figs. 5, 6.—*Allorisma sulcata.* Two specimens from the same locality, of medium size, Fig. 5 somewhat incomplete posteriorly, and therefore appearing to gape posteriorly. Fig. 6 shows that the shell was closed all round. My Collection. (Page 422.)

Fig. 7.—*Allorisma sulcata.* A specimen having the outer test preserved, and showing the radiating rows of small tubercles, of which 7 *a* is a magnified view, and 7 *b* a view of the umbones, escutcheon, and lunule. From the Upper Limestone Series of Garngad Road, Glasgow. In the Collection of Mr. J. Neilson. (Page 422.)

Fig. 8.—*Allorisma sulcata.* A large example from the Lower Limestone Series of Beith, showing sinuated pallial line. My Collection. (Page 422.)

Fig. 9.—*Allorisma sulcata.* A young example from the Redesdale Ironstone. My Collection. (Page 422.)

Figs. 10, 11.—*Allorisma sulcata.* Two uncrushed examples with strongly marked ribs, Figs. 10 *a*, 11 *a*, showing the lunule and escutcheon. Same locality. My Collection. (Page 422.)

Fig. 12.—*Allorisma monensis.* The cast of a full-grown example, showing adductor muscle-scars and sinuated pallial line. From the Lower Limestones of Balasala, Isle of Man. With Fig. 12 *a*, a view from above, showing cast of lunule and escutcheon. My Collection. (Page 426.)

Fig. 13.—*Allorisma monensis.* An incomplete specimen, but possessing fragments of the test, showing the character of the external marking, anterior and posterior adductor muscle-scars, and sinuated pallial line. Same locality. In the Collection of Miss Birley. (Page 426.)

Fig. 14.—*Allorisma monensis.* The same specimen, showing the right valve, with a portion of the test preserved. (Page 426.)

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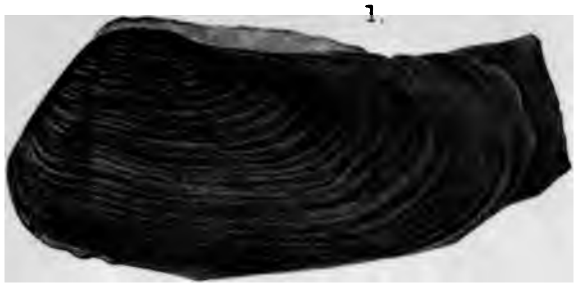

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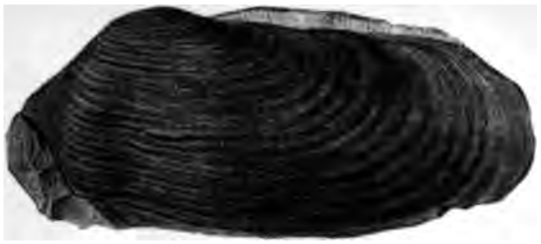

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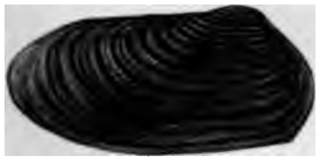

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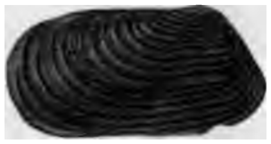

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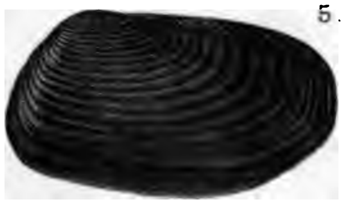

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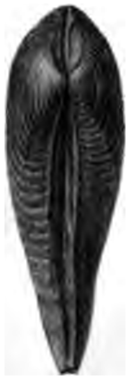

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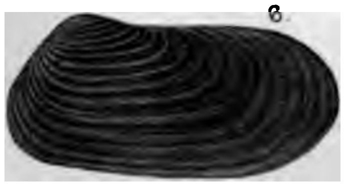

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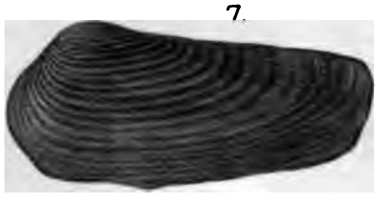

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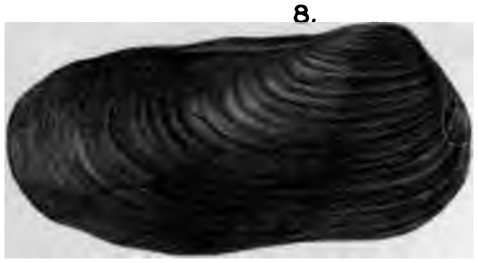

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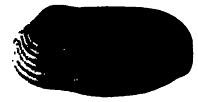

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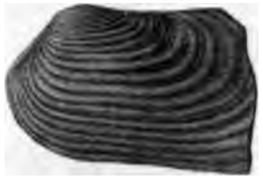

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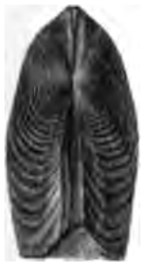

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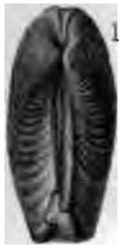

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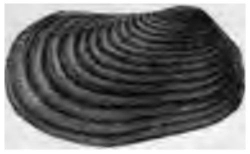

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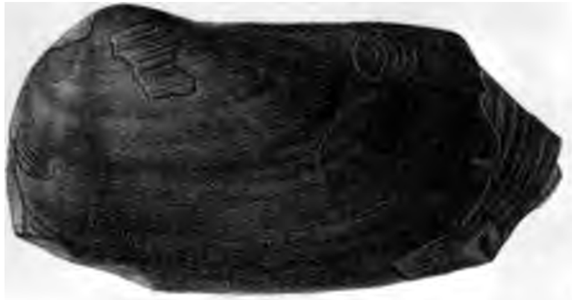

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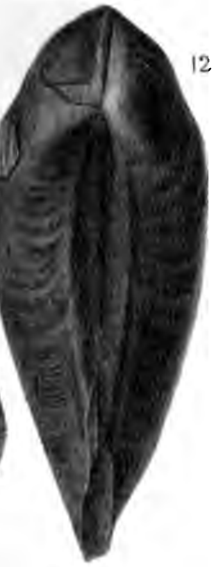

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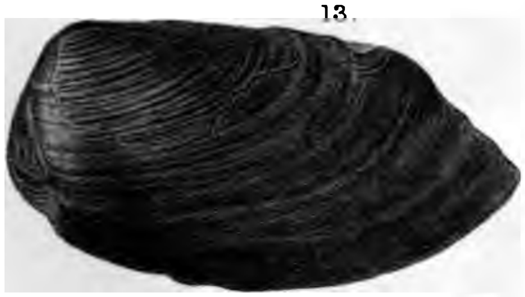

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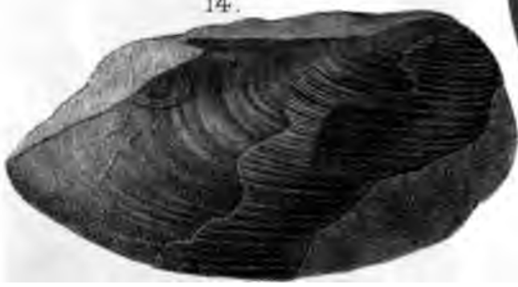

Searle del et lith.

Mintern Bros imp.

PLATE XLIX.

Fig. 1.—*Allorisma Ansticei.* An almost complete specimen, showing the tubercles on the external surface, with 1 *a*, a magnified view of the surface. From the Lower Limestone Series of Auchenmade, Ayrshire. In the Collection of Mr. J. Smith. (Page 428.)

Fig. 2.—*Allorisma Ansticei.* The type of Sowerby's species. From the Pennystone Ironstone, Coalbrookdale. In the Prestwich Collection at the Natural History Museum, South Kensington. Fig. 2 *a*, the same shell viewed from below. (Page 428.)

Fig. 3.—*Allorisma Ansticei.* A full-grown shell. Same locality. My Collection. Fig. 3 *a*, the same specimen viewed from above. (Page 428.)

Fig. 4.—*Tellinomorpha jucunda.* A left valve from the Carboniferous Limestone of Park Hill. In the Collection of the Geological Survey, Jermyn Street. (Page 432.)

Fig. 5.—*Tellinomorpha cuneiformis.* An almost perfectly preserved specimen from the Lower Limestone Series of Auchenskeith; with 5 *a*, a view from above. In the Collection of Mr. J. Smith. (Page 433.)

Fig. 6.—*Tellinomorpha cuneiformis.* A very fine example, showing the radiating rows of tubercles on the surface; with 6 *a*, a portion of the surface magnified. From the Lower Limestone Series of Hind og glen. Same Collection. (Page 433.)

Fig. 7.—*Tellinomorpha cuneiformis.* The greater part of the right valve of a full-grown shell. From the Carboniferous Limestone of Castleton, Derbyshire. My Collection. (Page 433.)

Fig. 8.—*Tellinomorpha cuneiformis.* The anterior portion of a left valve. Same locality and Collection. (Page 433.)

Fig. 9.—*Tellinomorpha cuneiformis.* A small example from the Carboniferous Limestone of Park Hill, Derbyshire. My Collection. (Page 433.)

Fig. 10.—*Sanguinolites interruptus.* A large full-grown example from the Carboniferous Limestone of Castleton, showing the left valve. Fig. 10 *a*, the right valve of the same shell. My Collection. (Page 383.)

PLATE XLIX.

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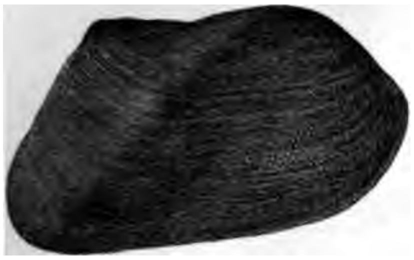

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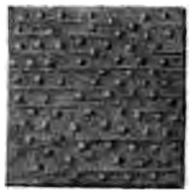

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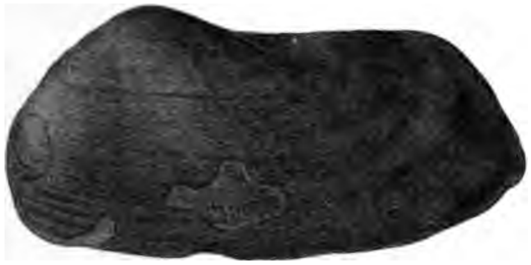

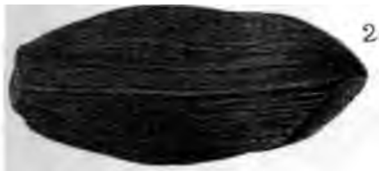

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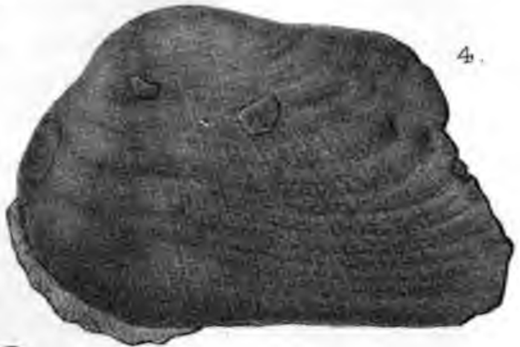

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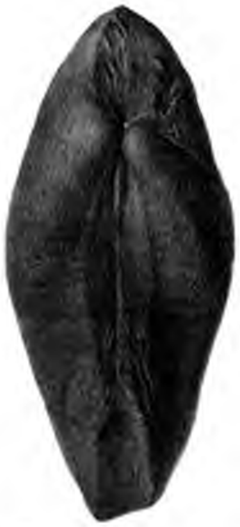

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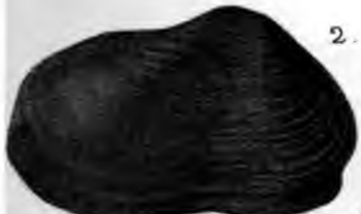

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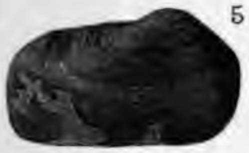

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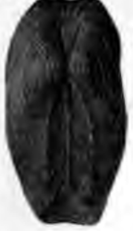

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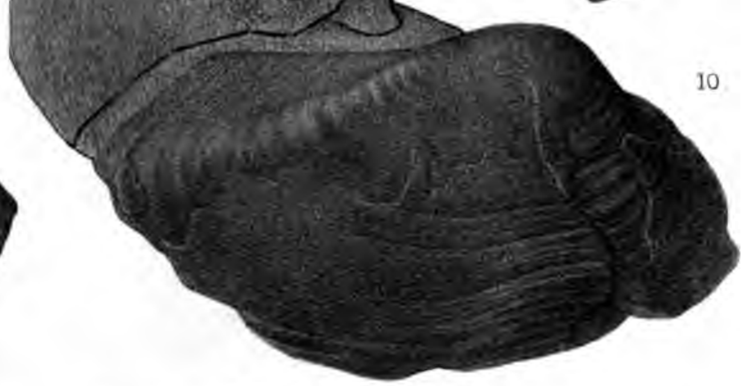

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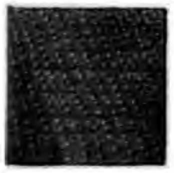

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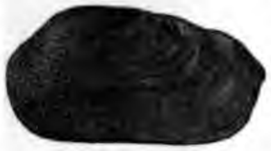

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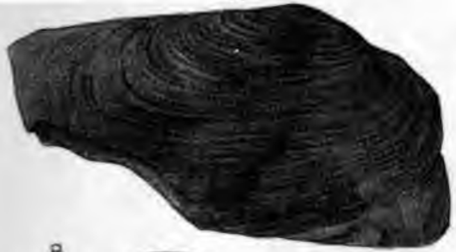

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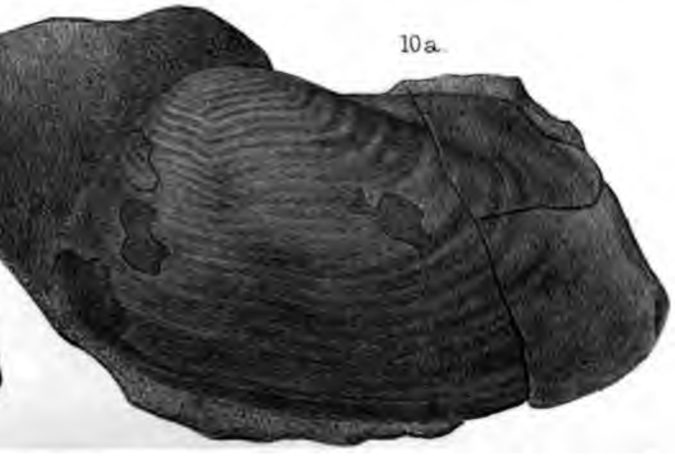

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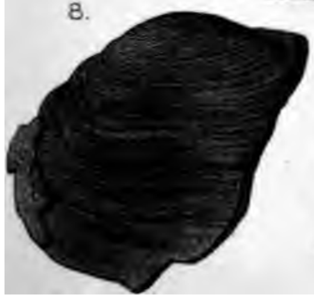

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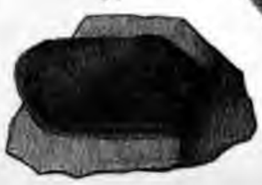

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PLATE L.

Fig. 1.—*Solenomya primæva.* The cast of the left valve of a very fine specimen, showing adductor muscle-scars (Portlock's unfigured type). From Agaloo, co. Tyrone. In the Collection of the Geological Survey, Jermyn Street. (Page 438.)

Fig. 2.—*Solenomya primæva.* Showing both valves. In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 438.)

Fig. 3.—*Solenomya primæva.*—A right testiferous valve. From the Carboniferous Limestone series, Ardross, Fife. My Collection. (Page 438.)

Figs. 4, 5.—*Solenomya primæva.*—A left and right valve respectively, showing adductor muscle-scars. From the Carboniferous Limestone of Lowick, Northumberland. In the Collection of the Woodwardian Museum, Cambridge. (Page 438.)

Fig. 6.—*Solenomya primæva.* The cast of a left valve, the type of M'Coy's *Sanguinolites radiatus.* From Killymeal, Dungannon, co. Tyrone. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 438.)

Fig. 7.—*Solenomya costellata.* The cast of a full-grown example, right valve. From the Carboniferous Limestone series of Yorkshire. My Collection. (Page 442.)

Fig. 8.—*Solenomya costellata.* The cast of a young example, left valve. From the Carboniferous Limestone of Lowick. In the Collection of the Woodwardian Museum, Cambridge. (Page 442.)

Fig. 9.—*Solenomya costellata.* A left valve with part of the test preserved. From the Coomb Limestone, Redesdale. My Collection. (Page 442.)

Fig. 10.—*Solenomya costellata.* A cast of the right valve, showing adductor muscle-scars. Same locality and Collection. (Page 442.)

Fig. 11.—*Solenomya excisa.* A large example from Northumberland. In the Collection of the York Museum. (Page 441.)

Fig. 12.—*Solenomya excisa.* A right valve from the Carboniferous Limestone series of Ardross, Fife. My Collection. (Page 441.)

Fig. 13.—*Solenomya costellata.* The type of M'Coy's *Sanguinolites costellatus.* From Killycloghy, Lisbellaw, co. Tyrone. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 442.)

Figs. 14, 15.—*Solenomya excisa.* Two examples, casts, from Lowick. In the Collection of the Geological Survey, Jermyn Street. (Page 441.)

Fig. 16.—*Solenomya excisa.* The cast of a left valve, probably from the same locality. In the Collection of the York Museum. (Page 441.)

Fig. 17.—*Clinopistha abbreviata.* The right and left valves, overlapping. From the Four-laws Limestone, the Coomb, Redesdale. My Collection. Presented to me by Mr. J. Dunn. (Page 446.)

Fig. 18.—*Clinopistha parvula.* An almost perfect example. Same locality and Collection. (Page 448.)

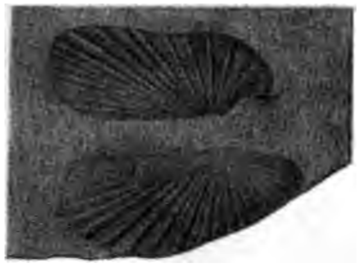
Fig. 19.—*Clinopistha parvula.* A left valve, almost all the shell gone. Same locality and Collection. (Page 448.)

Fig. 20.—*Clinopistha parvula.* A right valve as a cast, showing the adductor muscle-scars. Same locality and Collection. (Page 448.)

Fig. 21.—*Sanguinolites clavatus.* A very fine example of the left valve. From Newton Quarry, Knockhill, Fife. Calciferous Sandstone Series. My Collection. (Page 385.)

Fig. 22.—*Sanguinolites striatus.* A left valve with the test well preserved. Same locality and Collection. (Page 401.)

PLATE L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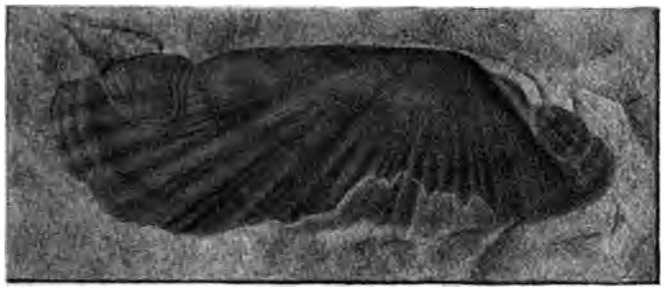
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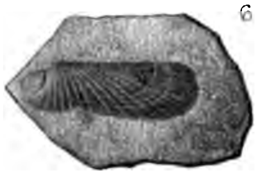
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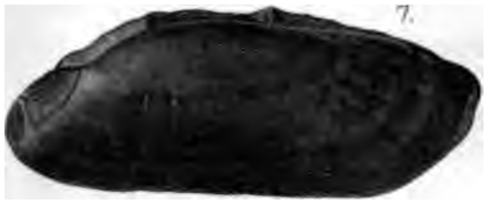
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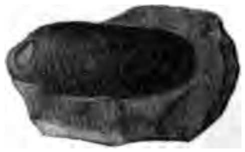
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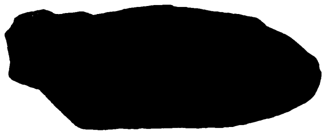
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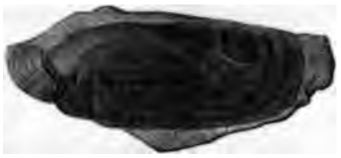
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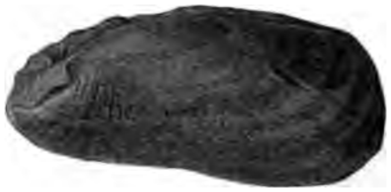
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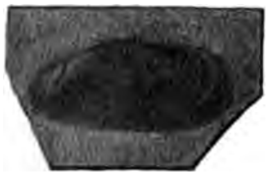
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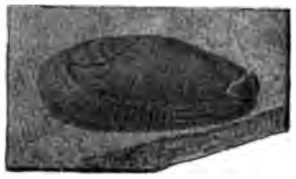
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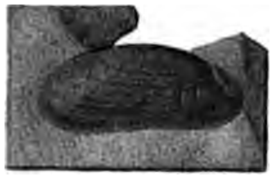
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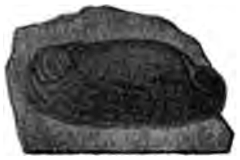
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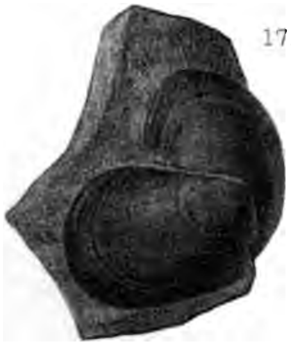
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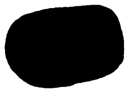
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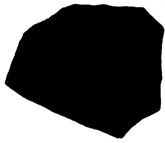
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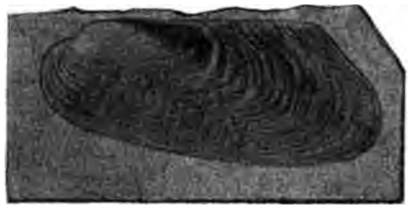
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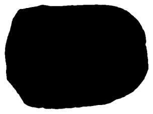
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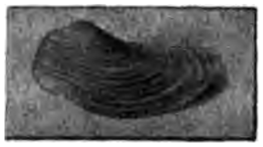
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Mintern Bros. imp.

PLATE LI.

Fig. 1.—*Sanguinolaria gibbosa.* Sowerby's type. Preserved in the Sowerby Collection of the Natural History Museum, South Kensington. (Page 404.)

Fig. 2.—*Solenopsis parallela.* A very young example from the Carboniferous Limestone series of Raven's Craig Castle, Kirkcaldy. In the Collection of the Geological Survey of Scotland. 2 *a*, the same enlarged. (Page 415.)

Fig. 3.—*Solenopsis minor.* M'Coy's type specimen. From Drumreagh. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 413.)

Fig. 4.—*Solenopsis minor.* A fully grown example from the Knife Scar Limestone, one mile north of Shap. My Collection. (Page 413.)

Fig. 5.—*Solenopsis minor.* The specimen figured by Portlock as *Solen pelagicus.* From Cloger, co. Tyrone. Preserved in the Collection of the Geological Survey, Jermyn Street. (Page 413.)

Fig. 6.—*Conocardium rostratum.* The type specimen of Sowerby's *Cardium elongatum.* Preserved in the Sowerby Collection, Natural History Museum, South Kensington; with Fig. 6 *a*, a view of the same specimen from above, and 6 *b*, a view from below. The specimen is imperfect at both extremities. (Page 453.)

Fig. 7.—*Conocardium rostratum.* A specimen from the Carboniferous Limestone of Park Hill, possessing the rostrum and a complete anterior end. In the Collection of the Geological Survey, Jermyn Street Museum. (Page 453.)

Figs. 8, 9.—*Conocardium rostratum.* Two examples without the rostrum. From the Carboniferous Limestone of Settle. In the Woodwardian Museum, Cambridge. (Page 453.)

Fig. 10.—*Conocardium Herculeum.* A specimen from Tournai, figured to show the position of the external ligament (*x*). Bought with a grant from the Royal Society, and to be placed in the Natural History Museum, South Kensington. (Page 452.)

Fig. 11.—*Conocardium Herculeum.* A perfect specimen of the left valve from the same locality; with Fig. 11 *a*, the interior of the same specimen, showing *a*, the hollow for the external ligament; *b*, the anterior adductor muscle-scar. My Collection. (Page 452.)

Fig. 12.—*Conocardium irregulare.* A specimen (nat. size) from the Carboniferous Limestone of Settle. In the Woodwardian Museum, Cambridge; with Fig. 12 *a*, an enlarged view. (Page 456.)

Fig. 13.—*Conocardium irregulare.* A somewhat less perfect example; with Fig. 13 *a*, an enlarged view. Same locality and Collection. (Page 456.)

Fig. 14.—*Conocardium inflatum.* The type specimen figured by M'Coy. From Carrickboy, co. Longford; with Fig. 14 *a*, a view from above. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 458.)

Figs. 15, 16.—*Conocardium inflatum.* Two specimens from Dooghybeg, co. Limerick. In the Collection of the Geological Survey of Ireland; with 15 *a*, a view of Fig. 15 from above. (Page 458.)

Fig. 17.—*Conocardium inflatum.* A specimen from Ragreagh. In the Collection of the Irish Geological Survey, with the stump of the rostrum preserved. Fig. 17 *a*, view from above. (Page 458.)

PLATE LI.

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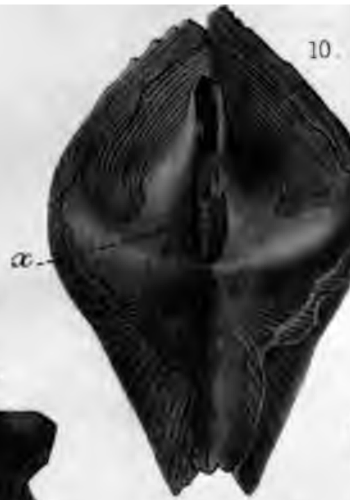

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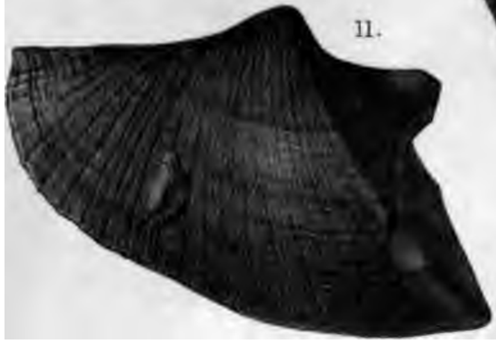

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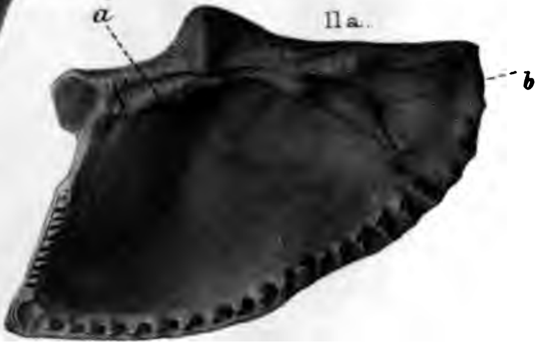

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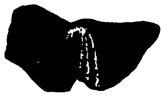

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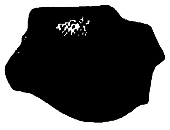

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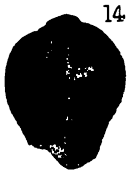

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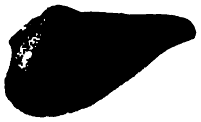

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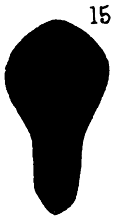

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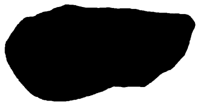

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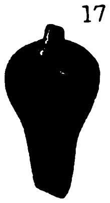

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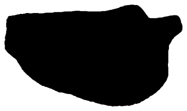


.H.Searle del. et lith.

Mintern Bros. imp.

PLATE LII.

Fig. 1.—*Conocardium fusiforme.* The type of M'Coy's species, from the Carboniferous Limestone of Malahide, co. Dublin. In the Griffith Collection, Museum of Science and Art, Dublin; with Fig. 1 *a*, the same specimen viewed from above. (Page 466.)

Fig. 2.—*Conocardium fusiforme.* A much-crushed specimen, showing the unribbed outer surface flattened by pressure, and at × the ribs between the inner and outer plates of the shell. Same Collection. (Page 466.)

Fig. 3.—*Conocardium Hibernicum.* The type of *Pleurorhynchus trigonalis* figured by Phillips. In the Gilbertson Collection, Natural History Museum, South Kensington. (Page 468.)

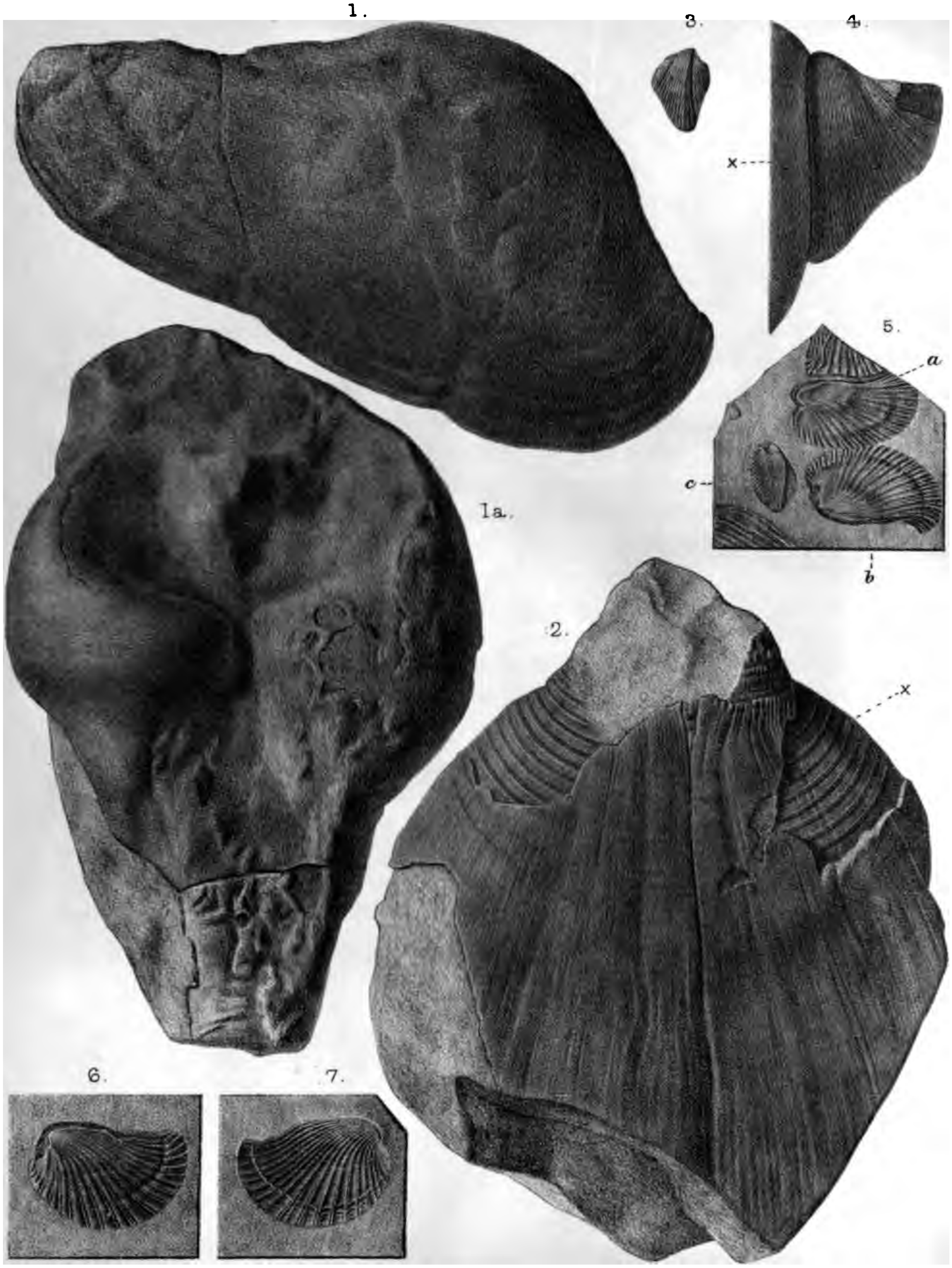
Fig. 4.—*Conocardium Hibernicum*, showing the shelly fringe (×), and its relation to the rest of the shell. From Rowerby, co. Limerick. In the Collection of the Geological Survey, Jermyn Street. (Page 468.)

Fig. 5.—*Chænocardiola Footii.* The type specimen figured by Baily from Coal Measures, Rosscliff, co. Clare. Fig. *a*, a cast of the left valve; Fig. *b*, a cast of the right valve; Fig. *c*, a much smaller example. In the Collection of the Geological Survey of Ireland. (Page 475.)

Fig. 6.—*Chænocardiola Footii.* The cast of the left valve. Same locality and Collection. (Page 475.)

Fig. 7.—*Chænocardiola Footii.* The impression of the exterior of a right valve. Same locality and Collection. (Page 475.)

PLATE LII.



L. Searle del. et lith.

Mintern Bros. lith.

PLATE LIII.

Figs. 1 and 2.—*Conocardium decussatum.* The cast of a right valve from Potmetal Plantation, Bogie, Kirkcaldy. In the Collection of the Geological Survey, Jermyn Street. (Page 471.)

Fig. 3.—*Conocardium alatum.* A specimen *minus* the rostrum, from Lesmahagow. Same Collection. (Page 473.)

Fig. 4.—*Conocardium decussatum.* A fine, almost perfect example of a young shell from Law, Dalry. In the Collection of Mr. J. Smith. (Page 471.)

Fig. 5.—*Conocardium alatum.* A strongly keeled variety from Settle. In the Woodwardian Museum, Cambridge; with Fig. 5 *a*, a view of the same specimen from above. (Page 474.)

Fig. 6.—*Conocardium Hibernicum.* The type of M'Coy's *Pleurorhynchus nodulosus.* From the Calp Series, Dromed, Mohill. In the Griffith Collection, Museum of Science and Art, Dublin. (Page 468.)

Fig. 7.—*Conocardium Hibernicum.* The type of M'Coy's *Pleurorhynchus giganteus*, incomplete, and with a portion of the outer surface of the shell wanting in front. From St. John's Point, Dunkineely. In the Griffith Collection of the Science and Art Museum, Dublin. (Page 468.)

Fig. 8.—*Conocardium Hibernicum.* A large example viewed directly from before backwards, showing the large shelly expansion. From Nanteenan, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 468.)

Fig. 9.—*Conocardium Hibernicum.* Showing the flattened posterior surface with the rostrum broken off. From Limerick. In the Collection of the Geological Survey, Jermyn Street. (Page 468.)

Fig. 10.—*Conocardium Hibernicum.*—A speciman from Nanteenan, co. Limerick, viewed from above. In the Collection of the Geological Survey of Ireland. (Page 468.)

Fig. 11.—*Conocardium Hibernicum.* The type of the species figured by Sowerby. From Ireland. In the Sowerby Collection, Natural History Museum, South Kensington. (Page 468.)

PLATE LIII.

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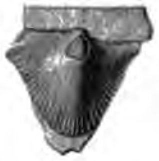

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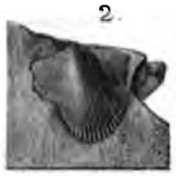

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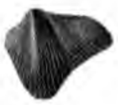

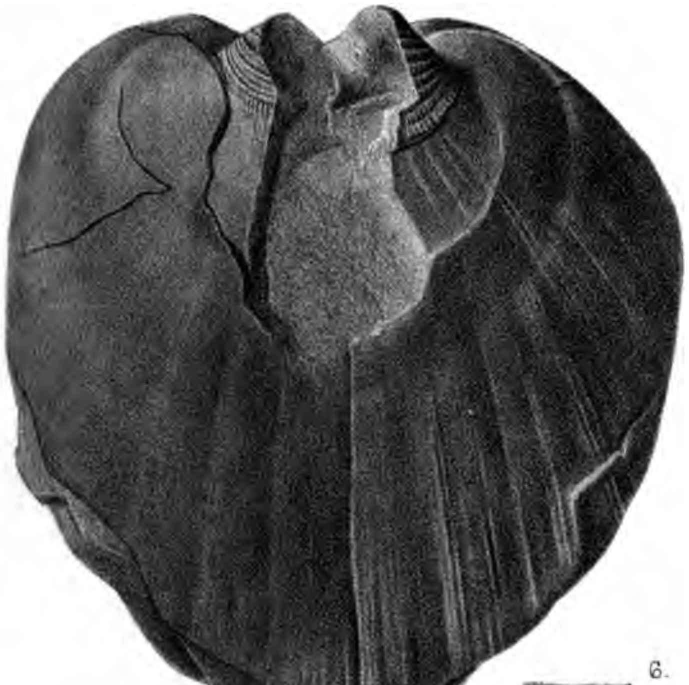

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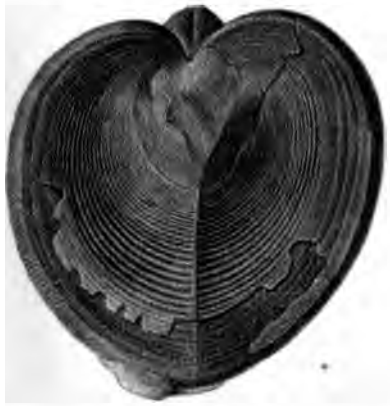

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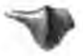

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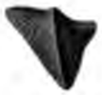

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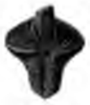

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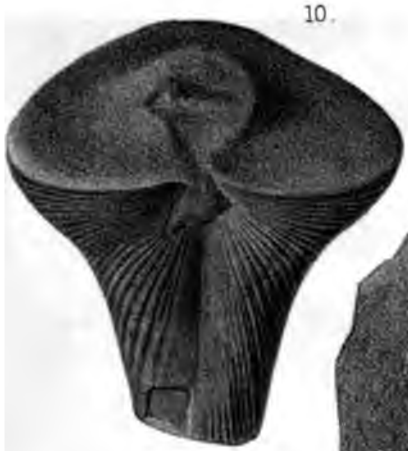

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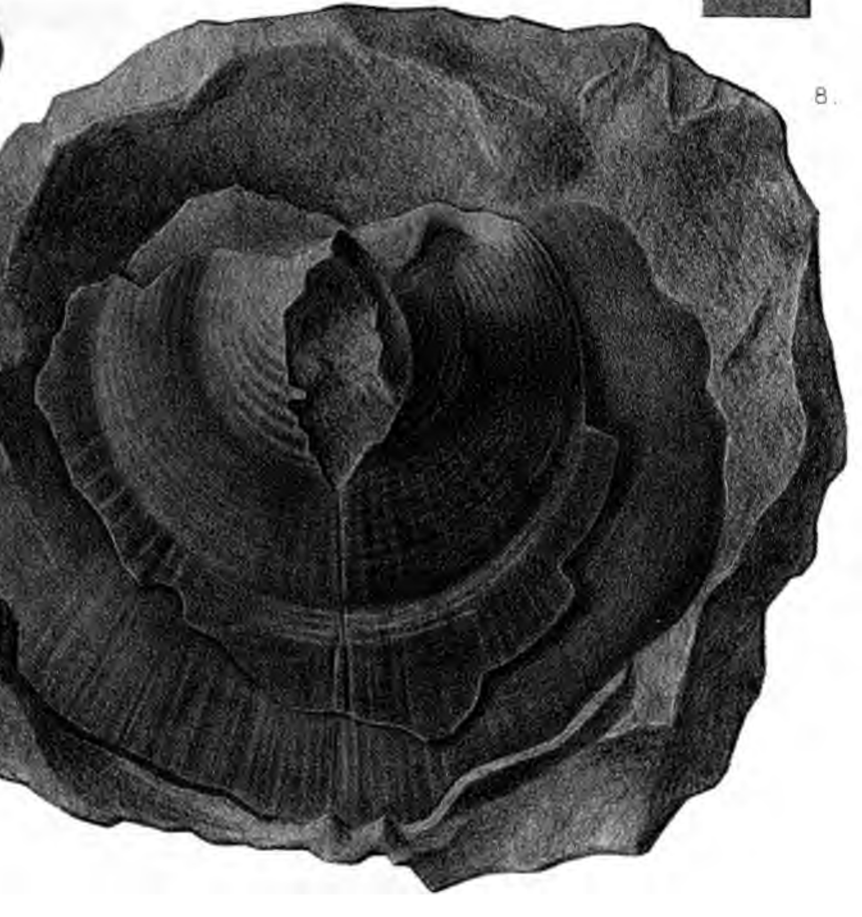

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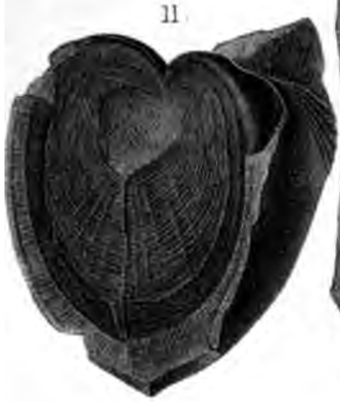

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PLATE LIV.

Fig. 1.—*Conocardium aliforme.* The type figured by Sowerby, preserved in the Sowerby Collection, Natural History Museum, South Kensington. (Page 460.)

Fig. 2.—*Conocardium aliforme.* Another type figured by Sowerby; with Fig. 2 *a*, a view from above. Same Collection. (Page 460.)

Fig. 3.—*Conocardium aliforme.* The type specimen figured by Phillips as *Cardium armatum;* Fig. 3 *a*, a view from the posterior end; and 3 *b*, a view from above. Preserved in the Gilbertson Collection, Natural History Museum, South Kensington. (Page 460.)

Fig. 4.—*Conocardium aliforme.* A specimen with the rostrum preserved, from the Carboniferous Limestone of Park Hill, Derbyshire. In the Collection of the Geological Survey, Jermyn Street. (Page 460.)

Fig. 5.—*Conocardium aliforme.* A cast of the interior, from Potmetal Plantation, Bogie, Kirkcaldy. Same Collection. (Page 460.)

Fig. 6.—*Conocardium aliforme.* A specimen which has lost the rostrum; with Fig. 6 *a*, a view from above. From the Carboniferous Limestone of Hill Bolton, Yorkshire. My Collection. (Page 460.)

Fig. 7.—*Conocardium aliforme.* A rather larger example, from the Carboniferous Limestone of Hill Stebden, Yorkshire. My Collection. (Page 460.)

Fig. 8.—*Conocardium aliforme.* A few specimens from the Carboniferous Limestone of Settle, in the Woodwardian Museum, Cambridge; with Fig. 8 *a*, a view of the posterior end and rostrum, and Fig. 8 *b*, a view from above. (Page 460.)

Fig. 9.—*Conocardium aliforme.* A fully grown example. Same locality and Collection. (Page 460.)

Fig. 10.—*Conocardium aliforme.* A specimen with occasional deep interruptions in the lines of growth. Same locality and Collection. (Page 460.)

Fig. 11.—*Conocardium Konincki.* A specimen from the Carboniferous Limestone of Nanteenan, co. Limerick. In the Museum of the Geological Survey, Jermyn Street. (Page 464.)

Fig. 12.—*Conocardium Konincki.* A fine specimen from Nanteenan, co. Limerick. In the Collection of the Geological Survey of Ireland. (Page 464.)

Fig. 13.—*Conocardium Konincki.* A specimen showing the posterior surface and long rostrum. Same locality and Collection. (Page 464.)

PLATE LIV

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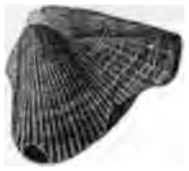

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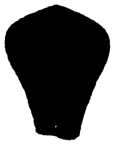

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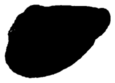

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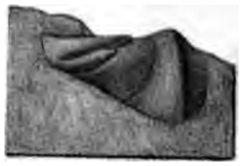

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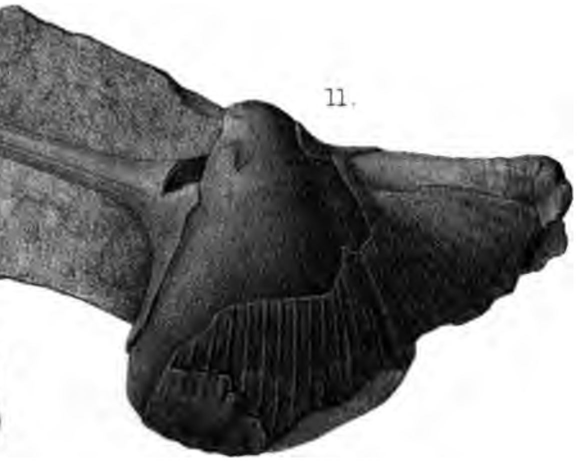

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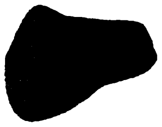

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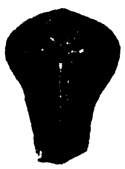

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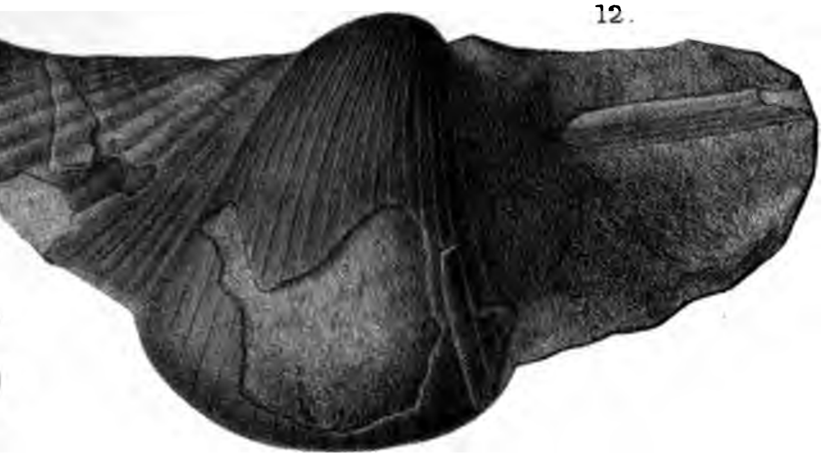

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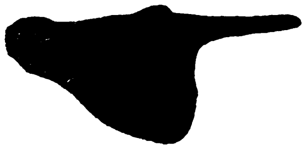

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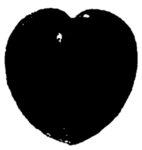

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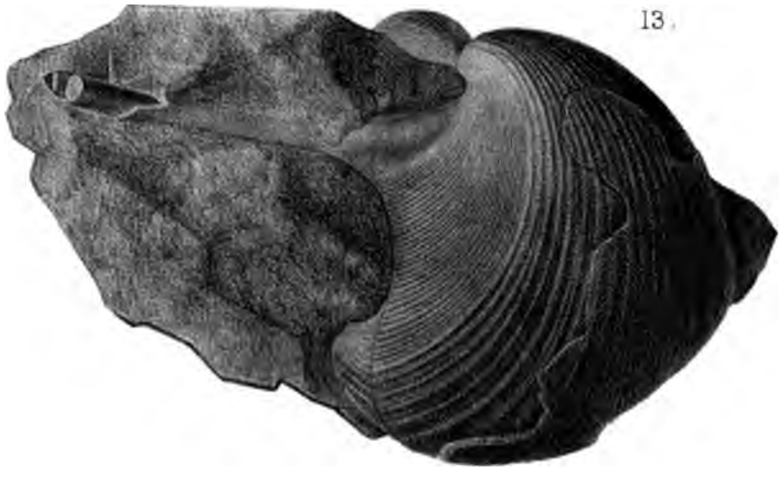

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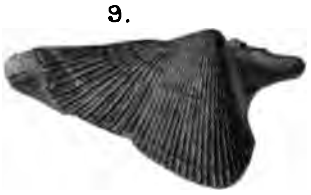

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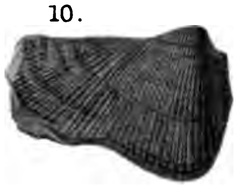

J. Searle del. et lith.

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PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1900.

LONDON:
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MONOGRAPH

ON THE

CARBONIFEROUS CEPHALOPODA

OF

IRELAND.

BY

ARTHUR H. FOORD, PH.D. (MÜNCH.), F.G.S.

PART III.

CONTAINING THE FAMILIES

TAINOCERATIDÆ, TRIGONOCERATIDÆ, TRIBOLOCERATIDÆ,
RINECERATIDÆ, COLOCERATIDÆ, AND
SOLENOCHEILIDÆ (IN PART).

PAGES 49—126; PLATES XVIII—XXXII.

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1900.

PRINTED BY ADLARD AND SON,
BARTHOLOMEW CLOSE, E.C., AND 20, HANOVER SQUARE, W.

Family TAINOCERATIDÆ.

Genus TEMNOCHEILUS, *M'Coy*, 1844.

TEMNOCHEILUS CORONATUS, *F. M'Coy*. Plate XVIII, figs. 1 *a*, *b*, 2 *a*, *b*.

1844. NAUTILUS (TEMNOCHEILUS) CORONATUS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 20, pl. iv, fig. 15.
1860. TEMNOCHEILUS CORONATUS, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 56.
1878. NAUTILUS CORONATUS, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, Palæont., tom. ii), pt. 1, p. 115, pl. xxiv, fig. 2.
1894. TEMNOCHEILUS CORONATUS, *A. H. Foord and G. C. Crick*. Geol. Mag., dec. 4, vol. i, p. 295 (woodcut).

Description.—Shell thick-discoid, subglobose, the inner whorls exposed in a wide and deep, crateriform umbilical cavity. The whorls are about three in number, with a central vacuity of moderate size and elliptical shape. The section is trapezoidal in form, the ventral area being much wider than the dorsal, which it overhangs considerably. The ratio of the vertical to the transverse diameter of the whorls may be reckoned at about 22 : 47. The periphery is gently rounded, the margins being marked by the characteristic tubercles. The umbilical walls are very steep, their sides slightly inflated in the lower half. The enrolment completely covers the ventral area up to the row of tubercles, which are thus visible on the inner whorls from their first development.

The septa (not well seen in any of the specimens that have come before me) are about 10 mm. apart on the ventral area, where the diameter of the shell is 90 mm.; they are, therefore, very numerous. The siphuncle appears to be a little above the centre, judging by its position in the type specimen, which is much distorted.

The ornaments consist of a row of tubercles situated at the angle formed by the junction of the peripheral area with the umbilical wall. Beginning at about the mid-length of the first whorl as obscure undulations, the tubercles gradually increase with the growth of the shell, until at about the second whorl they have become relatively large and prominent. They are of a flattened conoidal form, slightly elongated longitudinally. There are fourteen tubercles to a whorl in an adult shell. A faint raised line encircles the walls of the umbilicus on the inner whorls just beneath the row of tubercles. The periphery is quite smooth.

The young shell is beautifully marked with numerous longitudinal thread-like lines, which, being crossed by the equally regular and numerous lines of growth, produce a cancellated pattern of ornament comparable with that of the recent *Nautilus* in the same stage of growth, and of other coiled extinct Nautiloid shells (*Discitoceras, e. g.*) which lose this ornamentation in the adult shell. The transverse lines become obsolete before the end of the first whorl, but the longitudinal lines die out at about the first quarter of the second whorl, among the last to disappear being two lines just below the tubercles. Transverse lines of growth of a sigmoid form (much drawn out) are seen when the test is well preserved.

Affinities.—M'Coy ('British Palæozoic Fossils,' p. 588) remarks that the present species is distinguished completely from *N. tuberculatus*[1] by the great thickness or width of the mouth as compared with the diameter, the much more rapidly enlarging whorls, much deeper and narrower umbilicus, direction of the flattening of the tubercles, acutely elliptical form of the transverse section of the whorls, and forward instead of backward wave of the edge of the septa at the middle of the periphery. The accuracy of this summary of the divergent characters of the present species when compared with *Temn. tuberculatus* is established by an examination of the type specimen of the latter in the British Museum.

De Koninck, in describing the present species from Visé, Belgium, compares it with *N. biangulatus*, J. de C. Sowerby (*? Cœlonautilus cariniferus*, J. de C. Sowerby, sp.), and with *Nautilus tuberculatus*, J. Sowerby, and *Nautilus latus*, Meek and Worthen. He distinguishes M'Coy's species from Sowerby's and Meek and Worthen's by its smaller size, the greater relative height of its aperture, the depth of its umbilicus, and the form of the septa. As far as can be judged by the figures, there seems much to justify de Koninck's identification of the Visé fossil with *Temnocheilus coronatus;* and Mr. E. J. Garwood expressed the same view, in a letter to the writer, after having seen the specimens in the Natural History Museum at Brussels in 1893.

Remarks.—Until Mr. E. J. Garwood's fortunate discovery of this species in the Carboniferous Limestone of Stebden Hill, near Cracoe, Yorkshire,[2] it was but imperfectly known. The fine series he collected has added all the necessary information, though M'Coy, it is true, was enabled to somewhat amend his original description of the species by means of specimens afterwards obtained in the Carboniferous Limestone of Lowick, Northumberland.[3] One of Mr. Garwood's specimens, now in the British Museum, is figured for comparison with M'Coy's type, and to show the characters of the young shell, which are not seen in the latter (Pl. XVIII, figs. 1 *a*, 2 *a*).

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[1] J. Sowerby, 'Min. Conch.,' vol. iii, p. 90, pl. ccxlix, fig. 4.

[2] 'Geol. Mag.,' dec. 4, vol. i, p. 295.

[3] These are in the Woodwardian Museum, Cambridge.

margins of the peripheral area are produced into a prominent rounded ridge, outside of which and near to it there is a conspicuous keel extending the whole length of the shell. In the young shell there are about ten similar keels, five on each side, in the space between the ridge bounding the peripheral area and the dorsal keel. In well-preserved young specimens these lines may be so strong as to give a fluted appearance to the shell, but in the adult they become gradually obsolete. The shield-shaped form of the section may originate in the earliest stages of growth; it is, at any rate, fully developed in a young specimen to which I have had access, in which the diameter of the broken apical extremity is 6·5 mm. In addition to the ornaments above described, the whole of the peripheral area is covered with exceedingly fine, close-set, longitudinal lines, which persist in all stages of growth, becoming relatively coarser in the adult shell; they are not present on the sides of the shell. Fine transverse lines of growth pass in a sigmoid curve across the sides of the shell, continuing their course over the dorsal keel, and forming upon the peripheral area a well-marked, backwardly directed, hyponomic sinus, very conspicuous upon the body-chamber of old shells.

The septa are numerous; in the young shell they are 3 mm. apart upon the ventral area where its diameter is 18 mm. In a very large specimen, the dimensions of which are given below, the septa are 8 mm. apart, where the diameter of the shell measured upon its sides, from the keel bounding the peripheral margin to the one in the median line of the dorsal area, is 45 mm. The chambers are thus shallow. The necks of the septa are short and but slightly curved backwards.

The siphuncle is cylindrical, and is nearly 3 mm. in diameter where the lateral diameter of the shell is 22 mm.; thus it is about one-seventh the ventro-dorsal diameter of the shell.

Size.—The largest specimen known to me (a fragment contained in the "Grainger Collection" in the Free Public Library and Museum, Belfast) consists of the greater part of the body-chamber and one air-chamber. Its dimensions are as follows:—Greatest length, measured along the outer curvature, 195 mm.; dorso-ventral diameter of the smaller extremity 37 mm., of the larger 70 mm.

Remarks.—At present only two species of *Trigonoceras* have been recognised, viz. *T. paradoxicum*, J. de C. Sowerby, and *T. aigoceras*, G. zu Münster,[1] but there appears to be some reason for believing that there is a third species. Professor Hyatt remarks ('Geological Survey of Texas, Fourth Annual Report,' 1892, p. 405) that Sowerby's species is quite distinct from the Belgian one, the latter being apparently without any longitudinal ridges; the unique specimen described and figured by de Koninck[2] is, however, a cast, and would hence fail to show any ridges, or would show them so faintly as to cause them perhaps to be overlooked. A specimen from St. Doulagh's, which came under my notice (it is not now accessible to me), may prove to be a distinct species; it is more rapidly tapering and more slender, and has a stronger curvature than *T. paradoxicum.* On comparing the curvature of the two species (assuming for the moment that they are distinct) it is found that in the St. Doulagh's shell the greatest curvature upon a chord of 70 mm. subtending the concave side is 25 mm.; while in a specimen of *T. paradoxicum* from Clane, now before me (Pl. XVIII, figs. 3 *a*, *b*), the greatest curvature, upon a chord of 70 mm. subtending the concave side, is 6 mm., or about one-fourth the above amount—a very considerable discrepancy.

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[1] *Cyrtocera aigokeros*, 'Beiträge zur Petrefactenkunde' (1st edit.), 1838, Heft 1, p. 33; 2nd edit., 1843, Heft 1, p. 56, Taf. 1, figs. 7 *a*, *b*; Taf. 2, fig. 1.

[2] 'Calc. Carb.,' pt. 2, p. 7, pl. xxxii, figs. 3, 3 *a*, 3 *b*.

A fragment from Clane in the Grainger Collection shows narrow bands of colour of a dark brown hue and of a zigzag pattern, curving a little as they approach the dorsal keel (Pl. XVIII, fig. 5).

It is unfortunate that the specimen mentioned by M'Coy as exhibiting the incurved apical extremity was contained in a private collection, that of the Rev. Dr. Sirr. The prospect of tracing this collection is now, after such a long lapse of years, hopeless, and we must trust to renewed search for the completion of our information regarding the structure of *Trigonoceras.* My friend Mr. Joseph Wright, F.G.S., of Belfast, informs me that he saw, many years ago, two specimens of *Trigonoceras* in the Museum of Science and Art, Dublin, each with the apex preserved, as described by M'Coy. These also have long since disappeared. It is satisfactory, however, to have M'Coy's observation confirmed by so competent an observer.

Localities.—Clane, county of Kildare; Rathkeale and Doohyle (near Rathkeale), county of Limerick; St. Doulagh's, county of Dublin.

Genus CŒLONAUTILUS, *Foord*, 1891 (emend. *Hyatt*, 1893).

GROUP OF CŒLONAUTILUS PLANOTERGATUS.

a. CŒLONAUTILUS PLANOTERGATUS, *F. M'Coy*, sp. Plate XIX, figs. 1 *a*, *b*, 2 *a*—*c*.

1844. NAUTILUS (DISCITES) PLANOTERGATUS, *F. M'Coy.* Synop. Carb. Foss. Ireland, p. 18, pl. ii, fig. 2.

1860. DISCITES PLANOTERGATUS, *R. Griffith.* Journ. Geol. Soc. Dublin, vol. ix, p. 56.

1878. NAUTILUS PLANOTERGATUS, *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. ii), pt. 1, p. 117, pl. xxvi, figs. 1—3.

1891. DISCITES PLANOTERGATUS, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 2, p. 93.

1893. CŒLONAUTILUS PLANOTERGATUS, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 407.

Description.—Shell very thick-discoid, with subquadrate whorls, a deep umbilicus with step-like declivities from one whorl to the other, and a small central vacuity. The section of the whorls is hexagonal, and slightly concave along the median line of the peripheral area; the zone of impression is rather shallow. The body-chamber is rather large, and occupies nearly half of the last whorl. The rate of increase in the whorls is slow, and their width is about equal to that of the periphery. The umbilicus is wide and deep, and its step-like character very conspicuous. The sides are angular, both at the edge of the peripheral area and at that of the umbilicus, but there are no keels. In aged individuals the angularity of the umbilical margin is greatly lessened on the body-chamber in the vicinity of the aperture (Pl. XIX, fig. 1 *a*). The character of the aperture can only be inferred from the sinuous lines on the peripheral area, which show it to have had a moderately deep hyponomic sinus. The inner whorls exhibit the same quadrate character as the outer ones, which they resemble in miniature. Two obscure longitudinal elevations are present on the peripheral area of the young shell, which leave a very shallow median depression and a slight depression between them and the edge of the area. As the shell advances in growth, fine longitudinal thread-like lines or ridges are developed upon the peripheral area on each side of the shallow median depression, and in the proximity of the margin. These appear to become obsolete in the adult shell, as far as the material at my disposal enables me to judge. The surface of the test is covered with fine striæ of growth. These are well figured by de Koninck ('Calc. Carb.,' pt. 1, pl. xxvi, figs. 2, 3 *a*, 3 *c*).

The septa are fairly approximate. In the young shell, where the width of the peripheral area is 13 mm., they are 4 mm. apart in the median line; at a width of 17 mm. this distance has increased to 7 mm., and in the adult shell, at a width of 24 mm., they are 8 mm. apart, and in a large individual they are 12 mm. apart where the side measures 40 mm. across. The sutures are curved deeply backwards on the sides of the shell, and form sharply bent-back lobes upon the peripheral area. The sutural characters in this species are thus clearly marked, and are important aids in its identification (Pl. XIX, figs. 1 *b*, 2 *a*, 2 *b*).

The siphuncle, as seen in a natural section of a septum, is situated in the upper third, that is considerably above the centre (Pl. XIX, fig. 2 *c*).

Dimensions.—M'Coy affirms that this species often attains a diameter of 10 inches (254 mm.). The largest I have seen (Museum of Science and Art, Dublin) measures 160 mm. in its greatest diameter, the diameter of the umbilicus measured from the opposite margins being 75 mm. The central vacuity in another specimen measures 14 mm., thus far exceeding in the latter dimension de Koninck's figured specimens. The periphery is 45 mm. in width, the sides about 50 mm. in the widest part available for measurement.

Affinities.—*C. gradus*, though resembling the present species in the markedly quadrate form of its whorls, is easily distinguished therefrom by its much slower rate of increase, the much greater width of the peripheral area compared with the sides, and by its large central vacuity. Moreover it does not appear to attain the large size to which *C. planotergatus* develops.

Remarks.—Unfortunately the specimens available for my present study of the species, which includes M'Coy's type, are distorted by rock pressure; moreover they do not exhibit the complete growth of the shell through all its stages, hence my description is to some extent imperfect.

On the whole, de Koninck's figures of *C. planotergatus* give me the impression of a shell with less distinctly quadrate whorls and a much shallower umbilicus than the forms which have come under my notice.

This species was originally named *Nautilus hexagonus* by de Koninck,[1] but, as the name had already been used by J. Sowerby for a Jurassic species, it had to be discarded, and the specific name *planotergatus*, given by M'Coy[2] to what appeared to be the same form, was accepted by de Koninck[3] and subsequent writers. Prof. Hyatt,[4] however, on comparing specimens of the Belgian species (*Nautilus hexagonus*, L. G. de Koninck) contained in the Museum of Comparative Zoology, Cambridge, Mass., with M'Coy's species, comes to the conclusion that they are distinct. He remarks that the Belgian species "has a whorl in the young with more convergent[5] sides [than those of *C. planotergatus*], and is not so broad proportionately on the abdomen [periphery], and has therefore the gerontic [senile] form at an earlier stage." He thinks, therefore, that it is better to retain the name of *C. hexagonus;* on his authority I have accordingly omitted it from the list of synonymy of *C. planotergatus.*

Localities.—Cork (near the city); Rathkeale, county of Limerick.

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[1] 'Descrip. Anim. Foss. Terr. Carb. Belgique,' 1844, pl. xxv, fig. 1.

[2] 'Synop. Carb. Foss. Ireland,' 1844, p. 18, pl. ii, fig. 2.

[3] "Faune Calc. Carb. Belgique" ('Ann. Mus. Roy. d'Hist. Nat. Belgique,' Paléont., tom. ii), pt. 1, p. 117, pl. xxvi, figs. 1—3.

[4] "Carboniferous Cephalopods." Second paper. 'Geological Survey of Texas, Fourth Annual Report,' 1892, p. 408.

[5] This term signifies that the sides of the whorl are inclined outwardly or towards the periphery, instead of towards the umbilical margin ("divergent").

b. Cœlonautilus Doohylensis, sp. nov. Plate XIX, figs. 3 *a*, *b*, 4 *a*, *b*.

Description.—Shell small (young ?), thick-discoid, rapidly increasing in diameter, with probably three or three and a half whorls, all exposed in a very deep umbilicus, the outer one with extremely steep, step-like sides. The section of the shell is distinctly quadrate, but somewhat wider than high, and it is tetragonal. The peripheral area is broad and very slightly concave in the centre; the margins are acute. The sides in the inner whorls are considerably narrower than the peripheral area, but in the body-chamber the reverse is the case, the sides increasing rapidly in diameter towards the aperture. The umbilical declivity in the body-chamber is very steep, and terminates at the edge of the peripheral area of the whorl it embraces.

The septa are not seen, but the form of the sutures can be made out from the base of the body-chamber; they are deeply concave on the sides of the shell, and form rather a deep, backwardly directed sinus upon the peripheral area.

The siphuncle is very small, and situated a little above the centre of the septum.

The ornaments consist of four, irregularly spaced, very fine, thread-like, longitudinal lines on each side of the peripheral area; lines of growth are also faintly discernible, crossing the peripheral area transversely.

Dimensions.

	Specimen from Rathkeale.
Diameter of shell	50 mm.
Height of whorl (dorso-ventral) . . .	21 ,,
Width of whorl	20 ,,
,, umbilicus (from edge to edge) . .	21 ,,
,, ,, (from suture to suture) .	19·5 ,,
Thickness of whorl at umbilical edge . .	24 ,,

Affinities.—It was at first thought that this shell might be the young of *C. planotergatus*, but its much more rapid rate of increase, as evinced not only in the diameter of the sides but in the remarkable contrast in size between the last whorl and the one preceding it, entirely separates it from that species. I am not, however, able to say positively whether the specimen figured is a young or an adult one of its species, but the indications are in favour of its being the former; that is, there is no rounding off of the lateral angles indicative of the adult stage of growth, and its small size also suggests, though it does not of course prove, its immaturity.

From *C. gradus* the present species is easily distinguished by its more rapid rate of increase, and by the absence of the strong ridges ornamenting the peripheral area in the adult of that species (Pl. XIX, figs. 3 *a*, *b*). The two species are, however, clearly related.

Remarks.—The four specimens representing this species were all collected by me in a small mass of decomposing limestone in the railway cutting of the Limerick and Foynes Railway, near Rathkeale. The same fragment also contained many specimens of the young of *C. gradus*, A. H. Foord, an *Orthoceras* (*O. salvum*, L. G. de Kon.[1]), a small Gasteropod, and a species of Goniatite (*Pericylus Doohylensis*, A. H. Foord and G. C. Crick[2]), all admirably preserved and showing their finest ornamentation.

Locality.—Doohyle, county of Limerick.

c. CŒLONAUTILUS GRADUS, *A. H. Foord.* Plate XX, figs. 1—9.

1891. CŒLONAUTILUS GRADUS, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 2, p. 126, fig. 19.

1893. STROBOCERAS GRADUS, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 411.

Description.—Shell thick-discoid, composed of two and a half or nearly three whorls, all exposed in a deep, step-shaped umbilicus, having a very large central vacuity. Section of the whorls distinctly quadrate and tetragonal. The peripheral area is broad and slightly depressed along the median zone, with two distinct keels on each side of it, one on the outer or lateral edge, the other just inside of this. Bordering the inner keel on each side there is a slight prominence, the space between these prominences forming a shallow depression. The sides are considerably narrower than the peripheral area; thus, where the latter is 18 mm. across, the former measure only 12 mm. In the young shell this discrepancy goes still further; thus, where the sides of the whorl are 5 mm. in width, the peripheral area is 9 mm. across. The sides are slightly convex, and slope outwards towards the umbilical margin (Pl. XX, fig. 4). They bear on the inner whorls faint transverse folds with dimple-like depressions between them; these become obsolete as the shell attains the adult stage. The body-chamber occupies about half a volution. Towards the aperture the peripheral angles become rounded off both in the young and in the adult shell; in the latter, distinct thick folds, forming tubercular elevations, may be developed on the peripheral border

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[1] 'Calc. Carb. Belgique,' pt. ii, p. 67, pl. xli, fig. 6.

[2] 'Cat. Foss. Ceph. Brit. Mus.,' pt. 3, 1893, p. 151, fig. 72.

(Pl. XX, fig. 3), the keels having become obsolete or very faint. The aperture has a deep hyponomic sinus, on each side of which there are prominent lobes or crests (Pl. XX, figs. 3 and 6); viewed laterally it presents a graceful sigmoid curve (Pl. XX, fig. 3).

The ornaments of the test in the young shell consist of five irregularly spaced, exceedingly fine, thread-like longitudinal lines on each side of the peripheral area; these are replaced by two prominent keels in the adult shell, as already described. The whole surface is covered with very fine, transverse lines of growth, which form in the young shell minute, but quite distinct, crenulations in crossing the peripheral keel. In the adult shell they form a deep sinus upon the peripheral area, corresponding with that of the aperture. Upon the peripheral area of the adult shell a series of extremely fine longitudinal lines cover the two keels, but they do not extend beyond them laterally.

There appears to be no impressed zone in the young shell, but instead a slight flattening of the dorsal area is seen upon the inner whorl. The dorsal area of the initial volution (bordering the central vacuity) is raised into a faint median keel (Pl. XX, fig. 9), with other still fainter ridges on each side of it.

Upon the cast of the body-chamber in the adult shell the "Runzelschicht" is very distinctly preserved, consisting of rows of fine circular pittings arranged transversely to the longer axis of the shell.

The septa are extremely numerous, six occupying the space of 13 mm. near the body-chamber of an adult shell whose lateral diameter is from 11 mm. to 13 mm. at the place measured (Pl. XX, fig. 2). Upon the peripheral area of a young shell five occupy the space of 8 mm.; they here curve slightly backwards, as also upon the sides, making a sharp bend in crossing the angular margin (Pl. XX, fig. 7 *b*).

The siphuncle is situated in the upper third of the septum, maintaining this position apparently in all stages of growth (Pl. XX, figs. 4 and 9).

Dimensions.

	Adult.	Young.
Diameter of shell . . .	57 mm.	32 mm.
,, umbilicus (from edge to edge) .	32 ,,	21 ,,
,, ,, (from suture to suture)	26 ,,	15 ,,
,, central vacuity . .	? ,,	7 ,,
Height of outer whorl (dorso-ventral) .	19 ,,	11 ,,
Thickness of whorl at umbilical edge .	28 ,,	14 ,,

Affinities.—This species is most nearly related to *C. planotergatus*, from which it is distinguished by its slower rate of tapering, the strong keels upon the peripheral area, and the incipient folds upon the inner whorls. The width of the peripheral area in comparison with that of the sides is also much greater than in *C. planotergatus.* From *C. subsulcatus,* Phill. sp., the present species differs in its less rapid rate of increase, closer septa, proportionately broader periphery, and much larger central vacuity.

Remarks.—The specimens which I regard as the young of the present species, several of which are figured on Pl. XX (figs. 5—9), are, I think, of considerable interest. I collected about a score of them in a piece of rock of such a size that it could easily be lifted. They are nearly similar in size (the largest only 35 mm. in diameter), several of them showing the margin of the aperture, proving them to be complete individuals. The rock, a decomposing limestone, easily yielded to the hammer, and thus its fossil contents were extracted with little difficulty, the only drawback being that the shells were so numerous and so close together that several had to be sacrificed in securing a few complete ones.

I had some hesitation at first in deciding that these small individuals were the young of *Cœlonautilus gradus,* A. H. Foord, rather than an independent species, but there appears to be sufficient data for this determination of them, though I have not enough material to justify me in breaking away the older whorls of *C. planotergatus,* and thus exposing the complete young shell for comparison with the small shells in question. An important point in favour of my view of their relationship to *C. gradus* consists in the presence of those peculiar incipient folds which are conspicuous in that species, and to this must be added the possession of a proportionally large central vacuity (cf. Pl. XX, figs. 1 *a* and 5). Furthermore, the form and proportions of the whorls in the small individuals are similar to those of *C. gradus,* so far as can be made out from the exposure of the inner whorls in the umbilical depression of a perfect individual, and from sections of the whorls in a broken one belonging to that species. Professor Hyatt regards this species as probably a member of his genus Stroboceras,[1] and he refers to the prominent transverse folds figured by me in the young whorls which show its affinities with *Trigonoceras.* The folds are faint, not prominent; the figure (*loc. cit.,* fig. 19) makes them too distinct. My own opinion is that it belongs properly to *Cœlonautilus,* and I think there is good ground for this view of its relationship when its general features are taken into account, and it is compared with the allied forms under which I have grouped it in this Monograph.

Localities.—Kildare (probably Clane); Rathkeale and Curraghbridge, county of Limerick.

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[1] "Carboniferous Cephalopods." Second paper. 'Geological Survey of Texas, Fourth Annual Report,' 1892 (1893), p. 411.

Genus STROBOCERAS, *Hyatt*, 1883 (emend. 1893).

GROUP OF STROBOCERAS SULCATUM.

a. STROBOCERAS SULCATUM, *J. de C. Sowerby*, sp. Plate XX, figs. 10—12.

1826. NAUTILUS SULCATUS, *J. de C. Sowerby.* Min. Conch., vol. vi, p. 137, pl. dlxxi, figs. 1 (cast), 2 (young).
1836. — — *J. Phillips.* Geology of Yorkshire, pt. 2, p. 233, pl. xx, figs. 31, 32.
? 1843. — — *J. E. Portlock.* Geology of Londonderry, p. 404.
1844. — (DISCITES) SULCATUS, *F. M'Coy.* Synop. Carb. Foss. Ireland, p. 19, pl. iv, fig. 14 (fig. not quoted in the text).
? 1860. DISCITES SULCATUS, *R. Griffith.* Journ. Geol. Soc. Dublin, p. 561.
1891. — — *A. H. Foord.* Cat. Fos. Ceph. British Museum, pt. 2, p. 95.
1893. STROBOCERAS SULCATUM, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 411.
[*Not* 1844. NAUTILUS SULCATUS, *L. G. de Koninck.* Desc. des Anim. Foss. du Terr. Carbonifère de Belgique, p. 545, pl. xlvii, figs. 10 *a*, *b*; 1878, Faune du Calcaire Carbonifère de la Belgique (Annales du Mus. Roy. d'Hist. Nat. de Belgique, tom. ii), pt. 2, p. 126, pl. xx, figs. 1—4.]

Description.—Shell discoid, compressed, of a lenticular form, composed of two and a half or three slightly embracing whorls, all of which are exposed in a rather shallow umbilicus, which has a small central vacuity; this is 4 mm. across in a ventro-dorsally compressed shell, whose diameter is 45 mm. (Pl. XX, fig. 11).

The apex or initial point is conical, and it is ornamented like the rest of the shell, the three ridges which occupy the most prominent elevation on the sides being developed upon it with proportional fineness.

The whorl in section is broadly sagittate, the periphery very narrow, slightly concave, and bordered by sharp keels. The sides are inflated in the lower two-thirds, with three or four fine spiral ridges upon the most prominent part, the lower keel forming the edge of the umbilicus. The upper third of the sides is divided by a narrow projecting ridge into two deep sulci, which are not quite so wide as the peripheral furrow.

The body-chamber occupies about half of the last whorl.

The septa are rather numerous, about twenty-six being contained in a complete whorl.

The siphuncle is situated very near the peripheral margin.

The surface of the test is covered by very fine and regular lines of growth, about six of which occupy the space of 1 mm. They are curved sigmoidally upon the sides, and form a deep, backwardly directed sinus upon the periphery, corresponding with the contour of the aperture. When the test is preserved these lines are easily seen with a lens of low power, and though merely lines of growth they are so regularly disposed as to constitute an important element in the ornamentation of the species.

Affinities.—This species is nearly related to *S. bisulcatum*, de Koninck, sp., but differs from it in having less compressed, transversely broader whorls, more strongly marked and persistent sulci on the sides, and rather closer septa. In a specimen of *S. bisulcatum* from Visé, Belgium, in the British Museum, the diameter of which is 42 mm., the height of the outer whorl is 16 mm., and its greatest thickness 11 mm. In Sowerby's type, fig. 2 of his plate (the specimen representing fig. 1 is lost), in the British Museum the measurements are—height of the outer whorl 10·25 mm., greatest thickness of the same 9 mm., the diameter of the specimen being 25·5 mm.

Comparing the septation of the two species, I find that in the inner whorls of an imperfect though undistorted specimen of *S. sulcatum* six of the septa occupy the space of 8 mm., whereas in one of de Koninck's figures ('Calc. Carb.,' pl. xxvii, fig. 7) of *S. bisulcatum* six septa fill the space of 10 mm. Without giving any measurements de Koninck states that the distance of the septa in these two species is about equal, though the septation in his figure shows the discrepancy just indicated. My statement ('Cat. Foss. Ceph. Brit. Mus.,' pt. 2, p. 95) that *S. sulcatum* has more distant septa than *S. bisulcatum* appears, therefore, to have been erroneous. It is to be regretted also that de Koninck gives no actual measurements, but only general observations, as above, on this point.[1]

Remarks.—The synonymy of this species which I have adopted requires explanation, and this can only be satisfactorily given by tracing its history. It was first described by Sowerby in the 'Mineral Conchology' (1829), the specific characters being incompletely given in the diagnosis, but treated with more fulness in the supplementary remarks which accompany it; both are here appended, as follows: "Discoid, minutely striated; whorls almost wholly exposed, ventricose, with two large furrows on each side and several small ones; front concave." It is further stated "the concave front is bounded by sharp edges; there is also a sharp elevation between the two furrows; the rest of the side is gibbose, with two or three very shallow broad furrows upon its most elevated part. The aperture is half as long again as it is wide, its sides of course indented; the siphuncle is placed just opposite to the inner indentation; the septa are numerous, with even edges."

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[1] I am indebted to the kindness of my friend Mr. G. C. Crick, F.G.S., for the measurements of the British Museum specimens given above.

The figures given by Sowerby represent a large cast and a very small specimen, in which the test with its ornaments is well preserved. The latter specimen is in the British Museum and is known to me.

Seven years later (1836) Phillips very briefly described a species under the name *Nautilus sulcatus*, Sowerby; his figure of it, though roughly sketched, adequately represents Sowerby's species, and there is nothing in the description, short as it is, to contradict the testimony of the figure.

In 1844 de Koninck[1] described as local varieties of *Nautilus sulcatus*, Sowerby, two species, one of which has been recognised as the *Nautilus sulcifer* of Leveillé;[2] for the other Hyatt has proposed the name *Stroboceras belgicum*.[3] Of this I shall have something further to say later on.

M'Coy's 'Synopsis' (1844), part of which appeared simultaneously with de Koninck's 'Description des Animaux fossiles,' &c., contains a most careful description and a figure of Sowerby's species such as leaves no doubt in my mind that the Irish form is identical with the English one. Unfortunately M'Coy in the description omitted all reference to his figure of the species ('Synopsis,' pl. iv, fig. 14), which is quite unaccountably named in the plate "*bisulcatus*," as if the author had intended to give the Irish shell that name, but had changed his mind, and, taking the more correct course, identified it with Sowerby's species. De Koninck[4] noticing this circumstance, and regarding M'Coy's species as distinct from Sowerby's, makes use of the name "*bisulcatus*," and constitutes M'Coy the author of the new species, which is founded, be it remarked, upon the figure only, de Koninck's reference being limited to the words 'Synopsis,' pl. iv, fig. 14. It should be mentioned here that the name "*bisulcatus*" is not contained in the list of M'Coy's species published in 1862 by Sir Richard Griffith, and appended to that issue of the 'Synopsis,' but there is this important piece of information to be gleaned from it. At p. 273 of the 1862 text[5] is a "note" containing a number of errata, not only concerning names of species, but also the numbering of the plates and figures. The "note" is as follows:

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[1] 'Description des Animaux fossiles,' &c., p. 545.

[2] 'Cat. Foss. Ceph. British Museum,' pt. 2, 1891, p. 124.

[3] "Carboniferous Cephalopods." Second paper. 'Geological Survey of Texas, Fourth Annual Report, 1892' (1893), p. 411.

[4] 'Calc. Carb.,' p. 128, pl. xxvii, figs. 5—7, 9.

[5] I have called this the 1862 text or issue, but I do not mean to imply by this that it was a new edition; there is no warrant for such an assumption. I think that probably some sheets left over from the first (1844) issue were distributed with a new title-page, dated 1862. To this fresh issue Sir R. Griffith added his useful topographical and stratigraphical list of the Irish Carboniferous fossils, and thus supplied M'Coy's grievous omission of localities from his text.

> "The reader will find it convenient to number the plates consecutively in manuscript according to the following corrections, as the references in the text very generally disagree with the numbers and contents of the plates in consequence of an oversight by which a *provisional nomenclature was accidentally retained in printing the plates*, the text having been subsequently written."

Now it would appear that de Koninck never saw this "note," for he writes under his description of "*Nautilus bisulcatus*" ('Calc. Carb.,' i, p. 128) that in the first copies of M'Coy's work that were distributed the syllable *bi-* prefixed to *sulcatus* in the plates had been erased, leaving only the latter name; and accounts for this verbal alteration by saying it was probable that during the printing of the diagnosis of the species M'Coy had changed his mind as to their names, which was no doubt the case, but did not, I think, justify de Koninck in adopting a name "*bisulcatus*," a name which, as described in the "note" above quoted, belonged to a "provisional nomenclature," appearing only in the list of names appended to the plate whereon the species was figured. I regard M'Coy's figure[1] as essentially agreeing with "*Nautilus*" *sulcatus*, with which I unhesitatingly associate it, Irish specimens that have come under my notice upholding me in this conclusion. I have one now before me from Little Island, Cork, which is the only locality for it given in Griffith's "Localities of Irish Carb. Fossils," arranged as an appendix to the 'Synopsis' (p. 228).

I will take the opportunity here of correcting the synonymy of *S. bisulcatus*, de Kon., sp. (*Discites bisulcatus*), in the 'Cat. Foss. Ceph. Brit. Mus.,' pt. 2, p. 96, by deleting, in conformity with the foregoing observations, the references dated 1844 and 1855. I would also call the attention of the reader to my "remarks" in the work just quoted.

The Belgian species differs from Sowerby's (in which I include the one described and figured by M'Coy) in its more compressed form, as demonstrated in the following table of measurements, in which it will be seen that the height of the outer whorl is much greater in proportion to the thickness in the specimen from Visé than in those from Cork, Ireland, and Castleton (?), England.

Dimensions.

	Sowerby's type, Brit. Mus. (young).	Little Isl., Cork.	Visé, Belg.
Diameter (approximate) of shell . .	25·5 mm.	41 mm.	42 mm.
,, ,, umbilicus (from edge to edge) .	?	22 ,,	?
,, ,, umbilicus (from suture to suture	?	15 ,,	?
Height of outer whorl (dorso-ventral) .	10·25 mm.	12 ,,	16 mm.
Thickness of outer whorl . .	9 ,,	$10\frac{5}{6}$,,	$11\frac{2}{3}$,,

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[1] It is unfortunately the case that many of the specimens figured in the 'Synopsis' have been lost and amongst them the original of this figure.

It is also distinguished by having closer septa and less distinctly marked sulci than those in Sowerby's species.

It may not be superfluous to mention finally that I had not seen the 1862 issue of M'Coy's work when writing the 'Catalogue of the Fossil Cephalopoda' in the British Museum, no copy of it being contained in the library of that institution, and therefore, like de Koninck, I was then unaware of the existence of the "note" quoted above.

I have next to refer to Professor Hyatt's distribution of the group of forms to which the present species belongs. His observations upon them are very brief. Referring to *Stroboceras sulcatum*, J. de C. Sowerby, sp., he says, "This has smooth sides, is more compressed, and differs from the *Naut. sulcatus* of de Koninck, 'Calc. Carb.,' p. 27, for which I propose the name *S. belgicum*." The following European species are also referred to *Stroboceras* by Hyatt, *S.* (*Naut.*) *bisulcatum*, sp., de Koninck; *Phillipsianum*, sp., d'Orb., as figured by de Koninck; *Edwardsianum*, sp., de Koninck; *cordiostomum*, sp., de Koninck, and also *S.* (*Naut.*) *germanum*, Phillips, sp., as figured by d'Orbigny in the 'Paléontologie universelle,' pl. lxxxv.

I cannot understand upon what ground Professor Hyatt rests his statement that *Stroboceras sulcatum* has smooth sides; they are, on the contrary, beset with ridges and furrows, the more prominent of the former being quite conspicuous upon casts, even the lesser ridges not becoming obsolete till the body-chamber is reached.

Professor Hyatt does not indicate in detail the characters which separate *S. sulcatum*, J. de C. Sow., sp., from *S. belgicum*, A. Hyatt (= *N. sulcatus*, de Kon., *non* Sow.). The most obvious of them consist, firstly, in the relative dimensions of the whorl, which have already been tabulated; secondly, in the much larger size of the central vacuity in *S. belgicum*, conspicuous in one of de Koninck's figures ('Calc. Carb.,' pl. xxvii, fig. 2, selected by Hyatt as typical).

Localities.—Little Island, near Cork; Mullaghfarry and Crosspatrick, Killala, county of Mayo; Carnteel, county of Tyrone.

b. STROBOCERAS CRASSUM, sp. nov. Plate XX, figs. 13 *a*, *b*, *c*.

Description.—The only specimen is a worn fragment of a portion of the body-chamber of a thick discoid shell, most of the test of which remains. It is subtriangular or broadly sagittal in section, abruptly truncated above, expanding rapidly to the margin of the umbilicus below. The periphery is narrow, but much wider than in related species (cf. *S. sulcatum*, J. de C. Sowerby sp., p. 59); it is very slightly, almost imperceptibly concave, and is bounded on each side by distinct marginal keels. The edge of the umbilicus is bordered by a keel, a narrow furrow dividing the latter from a broad elevation on which there are the remains of two ridges, which have here nearly become obsolete, as is usually the case with the less prominent ornaments in this group of shells. Succeeding the elevation just mentioned is a broad and deep furrow, bounded above by a prominent rounded (in the worn condition of the specimen) ridge; between this and the peripheral border is another furrow, shallower than the one first described. The sides of the umbilicus descend very steeply to the sutural line of the preceding whorl. The impressed zone appears to have been shallow, but the test is wanting here. The lines of growth, which pursue the usual sigmoidal course transversely to the whorls, are but faintly visible here and there upon the test.

As the specimen is only a fragment of the body-chamber, neither the septa nor the siphuncle can be seen.

Affinities.—These are with *Stroboceras sulcatum*, J. de C. Sow., sp., but the great thickness of the fragment described clearly distinguishes it from that species, though it agrees therewith in the other features observable.

Dimensions.

	S. crassum.	*S. sulcatum.* (Sowerby's type, Min. Conch., vi, pl. dlxxi, fig. 2.)
Diameter of shell	? mm.	25·5 mm.
Height of outer whorl (dorso-ventral) .	19 „	10·25 „
Thickness of whorl at umbilical edge .	17 „	9 „
Width of periphery where height of whorl is 15·5 mm.	7 „	Irish specimen of *S. sulcatum.* 4·5 mm.
Depth of umbilical wall of outer whorl (where height of whorl is 15·5 mm.) from edge to suture .	7·5 „	4 „

These comparative measurements bring out very markedly the much greater thickness of the species under description, when compared with *S. sulcatum*.

Locality.—Ring, near Enniskillen, county of Fermanagh.

Genus APHELECERAS, *Hyatt*, 1883 (emend. 1893).

GROUP OF APHELECERAS MUTABILE.

a. APHELECERAS MUTABILE, *F. M'Coy*, sp. Plate XXI, figs. 1—3.

1844. NAUTILUS (DISCITES) MUTABILIS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 18, pl. iii, fig. 7.

1860. DISCITES MUTABILIS, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 77.

1878. Nautilus mutabilis, *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, Paléont., tom. iii), pt. 1, p. 121, pl. xxv, figs. 2 *a*—*c*.

1891. Discites compressus, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 2, p. 91, fig. 11 (*not Ellipsolites compressus*, J. Sowerby, Min. Conch., 1813, vol. i, p. 84, pl. xxxviii).

1893. Aphelaceras mutabile, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 413.

Description.—Shell of a very distinctly discoid shape, the sides tapering rapidly towards the periphery; much compressed; composed of three and a half to four quickly increasing volutions, the sides of which are completely exposed in a wide and shallow umbilicus, with a rather large central perforation. The section of the whorls in the adult shell is hexagonal, or, taken as a whole, sagittate with truncated apex; in the young the umbilical angles are inconspicuous, and the dorsal or anti-peripheral area is rather more rounded. The initial point is conical, and is sometimes detached from the second whorl (de Koninck). As the shell grows the umbilical walls become gradually deeper and somewhat concave, the suture of the shell having sometimes a slight rim in the last whorl. The edge of the umbilicus forms a thick, rounded angle owing to a thickening of the shell substance. The sides are slightly inflated in the adolescent stage but become flat in the adult; they terminate at the edge of the periphery in a sharp and prominent keel; the periphery is deeply concave and very narrow. The impressed zone is marked by a median ridge bordered by two grooves corresponding with the ventral furrow and its bordering keels. The body-chamber occupies a little more than half the last whorl; it becomes separated from the penultimate whorl in adult individuals for a distance of 18 mm. to 38 mm.

The septa are very numerous and deeply concave; thirty-six can be counted to one whorl in a shell whose diameter is 93 mm. (Pl. XXI, fig. 3). Where the whorl has a dorso-ventral diameter of 22 mm. they are 6 mm. apart, at a diameter of 15 mm. their distance is reduced to 5 mm., and again at a diameter of 7 mm. they are 3 mm. apart (Pl. XXI, fig. 3). Their distance apart is thus very gradually augmented. The sutures make rather a deep backward curve on the sides of the shell and on the periphery.

The siphuncle is a little above the centre, and maintains that position throughout the whole growth of the shell.

Ornamentation is only developed in the young shell; it consists of fine and regular longitudinal ridges covering the sides, and, to a certain distance, and more sparsely, the dorsal area. About eight of these ridges occur where the whorl, bordering the central vacuity, has a diameter of 5 mm.; they are strongest and most prominent near the suture of the shell, and become gradually finer from this point to the edge of the cavity; they are continued upon the dorsal area, but here they are again much finer, and become obsolete at a short distance from the initial point, at a place where the shell measures about 4 mm. across the sides. The ridges are crossed by very fine and close-set lines of growth, making a delicate and beautiful cancellated sculpture. This sculpturing is not continued beyond the innermost volution, and scarcely lasts for a complete whorl, the test becoming abruptly smooth or marked only by feeble lines of growth, except upon the periphery, where these lines are regular and very crowded, making a sinus which bends sharply back in conformity with the edge of the aperture.

Dimensions.

	Specimen from Clane in the Museum of Science and Art, Dublin.
Diameter of shell[1]	111 mm.
„ umbilicus (from edge to edge)	60 „
„ „ (suture to suture)	51 „
Height of outer whorl (dorso-ventral)	35 „
Width of periphery of outer whorl	12 „
Thickness of shell at umbilical edge	25 „
Depth of umbilical wall	5 „

The rapid increase in the growth of the shell is very strikingly shown by measuring the whorls transversely, from the inner to the outer whorl, when the figures are as follows: 5 mm., 14 mm., 35 mm.

A very large specimen in the Museum of Science and Art, Dublin, yields the following measurements: diameter of the shell, 123 mm.; that of the umbilicus, 68 mm.; height of outer whorl, 38 mm.

Affinities.—The most nearly related species is *Apheleceras discoideum*, de Kon., sp.,[2] but this is easily distinguished from the present species by its much more compressed form, and by the spiral ridges which extend to the beginning of the last whorl. Another related form is *Aphelceras difficile*,[3] de Kon., sp., in which the whorls are much wider transversely; they also overlap the preceding ones to a much greater degree than is the case in *A. mutabile*, and the central vacuity is much smaller and the septa more numerous than in the latter. *A. trochlea*, M'Coy,[4] also bears some relationship to *A. mutabile*, but it is distinguished by its much thicker proportions, and transversely broader whorls. ***Nautilus Mosquensis***, Tzwetaev[1] (= *subsulcatus*, Trautschold, *non* Phillips) somewhat resembles the present species, but the periphery is broader and not so concave, and the sutures are not so sinuous. *A. hibernicum*, A. H. Foord and G. C. Crick,[2] is closely allied to *A. mutabile*, but differs from it in its less slender proportions, less deeply channelled periphery, and in the non-contiguous condition of the first half-whorl.

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[1] The specimen measured has been rendered somewhat elliptical, apparently through rock pressure, which has operated in a direction contrary to that of the spiral axis of the whorls.

[2] 'Faune Calc. Carb. Belg.,' pt. 1, p. 133, pl. xxv, fig. 3.

[3] Ibid., p. 118, pl. xxvi, fig. 5.

[4] 'Synop. Carb. Foss. Ireland,' 1844, p. 19, pl. iii, fig. 4.

Remarks.—In the 'Catalogue of Fossil Cephalopoda, British Museum,' pt. 2, 1891, p. 91, *A. mutabile* is included in the synonymy of a species described by J. Sowerby under the name of *Ellipsolites compressus*.[3] It was afterwards discovered, however, by Mr. G. C. Crick and the writer that Sowerby's species was identical with the one described by that author as *Ammonites Henslowi*,[4] and it was further ascertained that *Ellipsolites compressus* (= *Ammonites Henslowi*) was a Goniatite belonging to the genus *Prolecanites*, Mojsisovics. This correction was published with full details and illustrations of the species in the 'Geological Magazine' for January, 1894, and subsequently in the 'Cat. Foss. Ceph. British Museum,' pt. 3, 1897; this allusion to the subject will therefore be sufficient.

Localities.—Rathfarnham, county of Dublin; Clane and Naas, county of Kildare; Cregg, near Nobber, county of Meath; Little Island, near Cork; Rathkeale, county of Limerick

b. APHELECERAS HIBERNICUM, *A. H. Foord and G. C. Crick.* Plate XXI, figs. 4—7.

1893. DISCITES HIBERNICUS, *A. H. Foord and G. C. Crick.* Geological Magazine, dec. 3, vol. x, p. 251 (woodcut, p. 254).

Description.—Shell discoid, compressed; whorls three (in largest individual measured), rather slowly increasing, the first half-whorl free, the rest in contact, but leaving the sides of the inner whorls entirely exposed; the impressed zone faintly defined on the body-chamber. The latter occupies fully one-half of the last whorl, and becomes free towards the aperture. Section of the whorl subcircular in the young, but becoming truncated-cuneiform and tetragonal in the adult. Umbilicus broad and shallow, with a large central vacuity; its walls sloping in such a degree as to form a very obtuse angle with the sides of the shell. Periphery convex in the free portion, concave in the last whorl, about one-half of the width of the side, exclusive of the umbilical slope; bounded on each side by a narrowly rounded, not very prominent rim. The sides are flattened in the adult stage, and converge rather rapidly from the umbilical edge towards that of the periphery.

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[1] 'Mém. Comité Géol. [Russia],' vol. v, No. 3, 1888, p. 52.

[2] 'Geol. Mag.,' decade 3, 1893, vol. x, p. 251 (woodcut).

[3] 'Min. Conch.,' vol. i, 1813, p. 84, pl. xxxviii.

[4] Ibid., vol. iii, 1820, p. 111, pl. cclxii.

The apex is bluntly conical and subcircular in section; the extremity is not seen in any of the specimens examined, but at a point which must be very near it the diameter is 2·5 mm., the ornaments being here quite clearly defined. The whorls begin with what Prof. Hyatt would describe as a gyroceran curve, which remains free to the extent of fully half a volution before the succeeding one comes in contact with it.

The septa (here described from a fragment which shows them only in the adolescent stage of the growth of the shell) are numerous, the sutures indicating by their curvature that the chambers were rather deep. Where the whorl has a transverse diameter of 9 mm. the sutures are from 3 mm. to 3·5 mm. apart; where this diameter has increased to 15 mm. the sutures are from 4 mm. to 5 mm. apart. At this (adolescent) stage of growth there are thirty-two septa in a whorl whose diameter is 55 mm.

The siphuncle occupies a position slightly above the centre of the septa; its diameter is not known, as it is only seen at the base of a fragment of the body-chamber.

The ornamentation consists primarily of a series of well-defined longitudinal (or spiral) ridges, which become more widely separated in proportion to the increase in diameter of the whorls; these ridges, crossed transversely by fine lines of growth, become thus minutely but distinctly crenulated. The lines of growth make a very deep and narrow, backwardly directed sinus in crossing the periphery, being here very close-set and regular. The longitudinal ridges are most strongly developed upon the sides of the shell, they tend to die off on the dorsal area, and disappear entirely on the completion of the first two whorls, or thereabouts.

Dimensions.

	Type specimen. (Brit. Mus.)	Large specimen. (Mus. Sci. and Art, Dublin.)
Diameter of shell . . .	72 mm.	115 mm.
,, umbilicus (from edge to edge) about . .	42 ,,	60 ,,
,, ,, (from suture to suture)	33 ,,	55 ,,
Height of outer whorl . . .	24 ,,	38 ,,
Width of periphery of outer whorl . .	10 ,,	—
Thickness of shell at umbilical edge about .	21·5 ,,	—

Affinities.—This species is very similar in many respects to *A. mutabile*, M'Coy, sp., differing therefrom in the free condition of the first whorl, in the much less deeply channelled periphery, in the crenulated character of the ornamentation of the inner whorls, and finally in its less compressed form.

It also resembles *A. discoideum*, de Kon., sp., but it tapers more rapidly, has much more numerous ridges, a less deeply channelled periphery, and the first whorl free. The sides also in *A. hibernicum* are more strongly convergent towards the periphery than those of *A. discoideum*, or, in other words, the latter has a more compressed shape.

Remarks.—This shell has been met with, up to the present time, only in the quarries at St. Doulagh's, where it is tolerably abundant. It is easily distinguished, even in fragments, from *A. mutabile* by its less compressed form and less deeply channelled periphery. In the young shell the first whorl being out of contact with the succeeding one is a distinctive feature.

A cast of the body-chamber shows at the base very distinct impressions of the shell-muscle as well as indistinct marks of the "Runzelschicht" (or "wrinkle layer;" marks supposed to represent the surface of the mantle of the animal). The former consist of two incised lines which are 3 mm. apart on the sides of the shell, getting gradually nearer towards the angles of the whorl. They follow in their course the contour of the last septum, whose outline is also impressed, rather faintly, upon the cast. There is also a series of short longitudinal indentations, crowded together, on the dorsal area situated in advance of, but almost touching, the incised lines of the shell-muscle. These have precisely the appearance produced by impressions of the thumb-nail when lightly applied to a soft substance, such as modelling wax. They doubtless served to strengthen the hold of the muscle to the shell, and recall similar points of attachment observed in *Cœlonautilus*,[1] as well as in the recent *Nautilus*.

Locality.—St. Doulagh's, county of Dublin.

. APHELECERAS TROCHLEA, *F. M'Coy*, sp.

1844. NAUTILUS (DISCITES) TROCHLEA, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 19, pl. iii, fig. 4.
1855. — — — — British Palæozoic Foss., Fasc. iii, p. 561, pl. iii H, fig. 16.
1878. — TROCHLEA, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, Paléont., tom. ii), pt. 1, p. 119, pl. xxvi, fig. 4.
1893. APHELECERAS TROCHLEA, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 414.

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[1] 'Cat. Foss. Ceph. British Museum,' pt. 2, 1891, p. 106, fig. 15.

Description.—"Discoid, of two and a half rapidly enlarging whorls, almost entirely exposed in an umbilicus with vertical sides; sides of the shell nearly flat, sloping with slight convexity from the rectangular edge of the umbilicus to the narrow, deeply concave periphery, which is bounded by two acutely angular edges; mouth widely trigonal, notched at apex by the concavity of the periphery; septa moderately numerous, having a broad backward curve on the sides, and a more abrupt one on the periphery, the two separated by an acute forward angulation on the lateral edge of each side; last chamber occupying nearly half of the body-whorl. Diameter five inches, proportional diameter of umbilicus $\frac{36}{100}$, antero-posterior diameter of mouth $\frac{44}{100}$, width of penultimate whorl $\frac{15}{100}$, width of mouth at outer edge of umbilicus $\frac{88}{100}$, width of concave periphery at mouth $\frac{14}{100}$" (M'Coy, 1855).

Remarks.—The species here described by M'Coy, first in his 'Synopsis' and afterwards in the 'British Palæozoic Fossils,' is represented in the "Griffith Collection" (Science and Art Museum, Dublin) by the fragment of a body-chamber figured in the first of these works (*loc. cit.*), the only specimen found, up to the present time, in Ireland. The more perfect specimen, above described, came from Kendal, Westmoreland.

The fragment is a cast of part of the body-chamber with the anterior portion broken off; it formed part of a very large individual, as the following measurements indicate: height of whorl (dorso-ventral) at anterior end 62 mm., at posterior end (a distance of 100 mm.) 50 mm., width of periphery at anterior end 24 mm., at posterior end 17 mm. Upon a chord of 100 mm., subtending the convex side, the greatest curvature is 15 mm.

The fragment is broken away on one side; on the other the side is very slightly convex and slopes gently from the umbilical to the peripheral border. The periphery is deeply concave, and, judging by the acute edge of the cast on each side of it, had prominent keels. A fragment of the test remains upon the periphery; it is almost covered by an encrusting Polyzoan; fine transverse lines of growth can, however, be seen bending backwards, but there are no longitudinal lines.

This species bears a strong resemblance to *A. exaratus*, de Kon., sp.,[1] a circumstance which was not overlooked by de Koninck in describing his species. The points of difference between them appear to be in the relative width of the peripheral and dorsal areas; thus in *A. exaratus* these areas are more nearly equal in width than in *A. trochlea*, or, in other words, the sides are more divergent from the periphery to the umbilical edge in the latter species than they are in the former. De Koninck also remarks that the form of the section in *A. exaratus* is more rectangular in *A. trochlea*, which naturally results from the greater divergency of the sides in the latter species just referred to.

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[1] "Faune Calc. Carb. Belgique," pt. 1, p. 120, pl. xxv, figs. 1 *a*, *b*.

Locality.—Cookstown, county of Tyrone.

MESOCHASMOCERAS,[1] gen. nov.

The first whorl forms a very wide curve, leaving an unusually large central vacuity which is the most striking feature of this genus, none other approaching it in this particular. The shell is throughout greatly compressed, as shown in the ratio of the two diameters of the section, the height being to the thickness respectively as 20 : 12. A third characteristic of great importance is the complete absence of ornamentation at all stages of growth. This differentiates it from *Apheleceras*, which it at first sight resembles, and to which it is apparently allied.

The young shell is nearly ovate in section, but before the first whorl is reached it becomes angular on the peripheral and umbilical borders. Before the completion of the first whorl the periphery gets flattened and the sides compressed (cf. Pl. XX, fig. 15 *d*), an imperfectly defined lateral angle being developed, which persists throughout the growth of the shell, but never becomes sharply defined. The overlapping of the whorls is so slight as not to extend beyond the borders of the periphery.

The septal characters are but imperfectly known, my material not being sufficient to enable me to make a complete study of them (Pl. XX, fig. 14 *b*).

The siphuncle is seen only in section (Pl. XX, figs. 15 *c*, *d*).

It will be useful here to tabulate the principal characters of *Mesochasmoceras*, and to place in contrast with them those of *Apheleceras* (Pl. XXI, figs. 1—7), thus:

Mesochasmoceras.	*Apheleceras.*
Whorls greatly compressed.	Whorls compressed.
Periphery a little narrower than the sides; slightly channelled.	Periphery extremely narrow; deeply channelled.
Umbilical vacuity excessively large.	Umbilical vacuity moderately large.
Test unornamented throughout.	Test ornamented in the young stage.
Ratio of height to thickness of whorl, respectively as 20 : 12.	Ratio of height to thickness of whorl, respectively as 25 : 20.

The genus *Mesochasmoceras* falls under Hyatt's family Trigonoceratidæ, which includes the following genera: *Trigonoceras*, M'Coy; *Cœlonautilus*, Foord, emend. Hyatt; *Stroboceras*, Hyatt; *Apheleceras*, Hyatt; *Mesochasmoceras*, Foord; *Subclymenia*, d'Orbigny; *Diorugoceras*, Hyatt (of doubtful validity, the single species [*infra*, p. 74] upon which it is founded being very imperfectly known).

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[1] From *μεσοχάσμα*, an opening in the middle; *κέρας*, a horn.

MESOCHASMOCERAS LATIDORSATUM, *F. M'Coy*, sp. Plate XX, figs. 14 *a*, *b*, 15 *a*—*d*.

1844. NAUTILUS LATIDORSATUS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 18 pl. iv, fig. 16.

Description.—Shell discoid, much compressed, with about two and a half volutions, the sides of which are entirely exposed in a large and very shallow umbilicus which has a remarkably large central vacuity. The section of the whorl, scutiform in the young, becomes in the adolescent stage of growth subquadrate and tetragonal, the adult becoming more compressed from side to side and hence more elongate dorso-ventrally. The zone of impression is slight and its boundaries faintly defined. The initial point of the apex is not seen, but the shell is present in one individual examined up to a very short distance from it, and measures where broken off 1·5 mm. in its dorso-ventral diameter, and 1 mm. in the transverse direction. The section of the young shell is nearly ovate, the angularities afterwards developed not being present at this stage. Before the first whorl has been attained the periphery becomes flattened, the dorsal or antiperipheral area, however, still remaining rounded, and it is not until the second whorl has begun that a faintly defined lateral angle or shoulder begins to be formed; this gradually becomes more distinct, and constitutes a definite, though never sharply defined angle to the umbilicus, whence the whorl slopes down to the suture formed by contact with the preceding whorl. The periphery which is narrow now becomes concave, but not deeply so, and it is bordered on each side by an inconspicuous keel. The sides, after the young stage of the shell is past, are flattened, or slightly convex, a faint depression being formed in the adolescent (neanic) stage near the keel, giving the latter more prominence at this part of the shell. The overlapping of the whorls does not extend beyond the peripheral margin.

The body-chamber occupies about half of the last volution.

The septa are moderately distant, and the curvature of their sutures indicates that the chambers were rather deep (Pl. XX, fig. 14 *b*). The sutures are 4·5 mm. apart where the transverse diameter of the whorl from the edge of the periphery to the suture of the shell measures 12 mm., this distance being reduced to 3 mm. where the diameter, similarly measured, is 11 mm.

The siphuncle is situated slightly above the centre of the septum.

The surface of the test is smooth, only some obscure folds being present here and there on the umbilical declivities. Lines of growth on the sides of the shell, mostly too fine to be seen except with a lens, are more easily discernible on the periphery, where they are crowded together, forming a deep, backwardly directed, and sharply bent sinus; some very obscure longitudinal lines occur also here.

Dimensions.	Large individual from Rathkeale. (Science and Art Museum, Dublin.)	
Diameter of shell, rendered somewhat elliptic by pressure	73	mm.
„ umbilicus (from edge to edge) . .	46	„
„ „ (from suture to suture) .	35	„
Height of outer whorl (dorso-ventral) . .	18·5	„
Width of periphery of outer whorl . . .	8·5	„
Thickness of shell at umbilical edge . . .	13	„

Remarks.—M'Coy's description of the present species was drawn up from a specimen half buried in the rock;[1] it is contained in the Museum of Science and Art, Dublin ("Griffith Collection"). He states that there are "very faint traces of spiral striæ on the inner or young volutions," but, with much more perfect material than M'Coy had, I have failed to see any such ornamentation, nor is it to be seen in the type specimen from which M'Coy's description was, presumably, drawn up.

Localities.—Clane, county of Kildare; Argoul South and Cragard, county of Limerick.

Genus DIORUGOCERAS, *Hyatt*, 1893.

DIORUGOCERAS PLANIDORSATUM, *J. E. Portlock*, sp.

1843. NAUTILUS PLANIDORSATUS, *J. E. Portlock*. Geology of Londonderry, p. 403, pl. xxxv, fig. 1.

1893. DIORUGOCERAS PLANIDORSATUM, *A. Hyatt*. Carboniferous Cephalopods. Geological Survey of Texas, Fourth Annual Report, 1892, p. 416.

As will be seen from Portlock's description here given, this is a very problematical form, and the utility of dealing with it afresh is perhaps open to question; were it not that Professor Hyatt has proposed a new genus for its reception, I should probably have passed it by, as I have not access to the specimen, and am not even aware of its present location.

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[1] It is drawn on the plate free from the matrix; the form and dimensions of the specimen, however, leave no doubt in my mind as to its representing the specimen in the "Griffith Collection."

Portlock begins his description by comparing his species with a Goniatite:

"A larger and flatter shell than Professor Phillips's,[1] which is described as 'very depresssed' back (in adults) truncate; umbilicus open; fine transverse bent striæ." Professor Phillips's species was about half the size of this, and the back is represented as quite flat; in this it is slightly concave and narrower. The sides are much flattened; and the umbilicus, represented by Phillips as open, but very small, is evidently in this also very small, if not entirely closed.

"The surface is not sufficiently preserved to exhibit striæ; but the septa can be traced, and appear more suitable to the Nautiloid than Goniatitic type. Diameter of disc 3·5 inches, thickness at back ·3 of an inch; sides much flattened; outer edge shallow concave; septa very concave.

"This differs from *Nautilus sulcatus*, and some other species with flattened or concave backs, by the volutions being concealed.

"*Locality.*—Derryloran, Tyrone, in light pinkish limestone."

Family TRIBOLOCERATIDÆ.

Genus TRIBOLOCERAS, *Hyatt*, 1883 (emend. 1893).

TRIBOLOCERAS FORMOSUM, sp. nov. Plate XXII, figs. 1, 2.

?1844. TEMNOCHEILUS CRENATUS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 21, pl. ii, fig. 9 (fragment).

Description.—Shell discoid, composed of two volutions having a very deep funnel-shaped umbilicus with a large central vacuity. The whorls, hexagonal in section in the young, become digonous in the adolescent and adult stages. The body-chamber occupies apparently half a volution. It is slightly detached from the preceding whorl near the aperture.

The periphery in the young and adolescent stages is broad, and is divided into three distinct zones, the centre being occupied by a low median elevation, bounded on each side by shallow furrows; ridged elevations, which are a little higher than the median one, fill the spaces on each side of the furrows and slope downwards to the keeled umbilical margin. From the latter there is an abrupt slope to the suture of the shell.

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[1] "*Goniatites truncatus*," Phill., 'Geology of Yorkshire,' pt. 2, 1836, p. 234, pl. xix, figs. 20, 21 (= *Glyphioceras truncatum*, Phill., sp., 'Cat. Foss. Ceph. British Museum,' pt. 3, 1897, p. 175, fig. 82).

As the shell grows towards the adult stage the median elevation becomes depressed and indistinct and gradually almost obsolete, the strong ridges on each side of it disappearing entirely in the senile stage, the body-chamber being here quite smooth. The umbilical declivities—for in this species there are no "sides," strictly speaking—are gently curved, becoming somewhat steeper when the body-chamber is reached. The zone of impression, which can only be seen on the body-chamber of one of the specimens before me, is so shallow as to be scarcely perceptible. It must be more pronounced in the young shell in which a median peripheral elevation is developed, as already described.

The septa are not seen, the only indication of their form, and that an imperfect one, being the impression left by the suture-line at the base of the body-chamber. Here, occupying the centre of the periphery, their outline describes a broad and shallow sinus, whose convexity is directed towards the aperture; this sinus is bounded on each side by an acute, posteriorly pointed lobe, the outline of which is continued obliquely upwards and outwards till it reaches the peripheral margin, at which point it bends backwards in a brief curve upon the extremely narrow zone representing the sides of the shell. The curvatures and lobes here described are coincident with and originate from the elevations and furrows developed upon the periphery.

The siphuncle is situated apparently a little above the centre. It is very obscurely seen, owing to the spaces between the septa being filled up with calc-spar.

The ornamentation consists of longitudinal ridges of variable strength. Upon the dorsal or anti-peripheral area of the adult shell there are none; my material does not enable me to say whether the young shell had any upon this part. There are four upon the umbilical declivity, the two lower being less prominent than the upper ones; the space between the lowest ridge and the one immediately above it is slightly wider than that between the other ridges. A very strong and prominent ridge forms the edge of the umbilicus, and at the same time that of the periphery; this is acute in the young shell, but it becomes rounded as the shell attains maturity, till finally in the senile stage it is obsolete, its position being marked only by a slight elevation.

The periphery in the young shell has eight ridges, excluding those forming its border; three of them are on each side of the median elevation, the inner ones forming the boundary of the furrows; the latter are shallow; the median elevation is not quite as high as the lateral ones; down its centre are two ridges which are much less prominent than those on each side of it, and as the shell grows they gradually become obsolete at about the end of the first whorl. The lateral ridges of the periphery appear to extend as far as the body-chamber, but to what length they go beyond this I am unable to say, as the test is not preserved upon the latter excepting a small portion of it near the aperture, where it is quite smooth.

The whole of the surface of the shell is covered with fine transverse lines of growth, which, in crossing the ridges, are thickened into small but conspicuous nodes which are somewhat elongated transversely. This crenulation gives a characteristic appearance to the ornamentation, which hence resembles that of *Vestinautilus semiglaber* (Pl. XXII, figs. 3, 4 *a*, *b*).

Dimensions.

	Adult specimen from Lisbane, Limerick.
Diameter of shell	100 mm.
„ umbilicus (from edge to edge) . .	79 „
„ „ (from suture to suture) .	43 „
Height of outer whorl (dorso-ventral) about . .	35 „
Width of periphery of outer whorl . . .	60 „

Affinities.—It is possible that the fragment of a body-chamber from Tirlecken, Shrule, county of Longford, described by M'Coy under the name of *Temnocheilus crenatus*, may belong to the present species, but its imperfect condition will leave this always a matter of uncertainty. M'Coy's specimen is in the "Griffith Collection" of the Science and Art Museum, Dublin.

Allied to *Triboloceras formosum* is *T. Meyerianum*, de Koninck, sp.; the distinctions between them are, however, quite clear. The section of the whorls (adult) in the latter is distinctly scutiform, the height in proportion to the width being much greater than in *T. formosum;* thus in the latter, where the height (dorso-ventral) of the whorl is 31 mm., the width, or lateral diameter, is 50 mm. In *T. Meyerianum*, where the height of the whorl is 44 mm., the width is 48 mm., a very slight difference compared with that which obtains in *T. formosum*. Another element of divergence between the two species is to be found in the ornaments, the ridges on the periphery in *T. Meyerianum* being differently disposed from those of *T. formosum;* those of the former are greatly elevated in the median line, four of the ridges standing out with great prominence and giving a pointed aspect to this part of the shell. The ridges upon the umbilical declivities are also more numerous in *T. Meyerianum* than in *T. formosum*.

Remarks.—This handsome shell, though here assigned to *Triboloceras*, seems to be a passage form between that genus and *Vestinautilus;* its very deep, crateriform umbilicus and broad periphery connecting it with the latter, from which, however, it is distinguished by the digonous form of its whorls and the numerous and prominent longitudinal ridges ornamenting its surface. It has, moreover, been remarked by Prof. Hyatt that *Triboloceras Meyerianum* is a specialised form of the group (I have already pointed out its close affinities with *T. formosum*), having a broad, elevated, median ventral (peripheral) zone. This feature is strongly characteristic of *Vestinautilus*, though it is not shared in by all the species of that genus—*V. Koninckii*, A. d'Orbigny, *V. cariniformis*, A. Hyatt, *e. g.*, having a concave peripheral area, just as *T. Meyerianum* has, contrary to its congeners *T. serratum*, *T. consobrinum*, and *T. intermedium*, a convex one.

Localities.—Lisbane, county of Limerick; Garrihies, county of Kerry.

Genus VESTINAUTILUS, *Ryckholt*, 1852 (emend. *Hyatt*, 1883, 1893).

VESTINAUTILUS SEMIGLABER, sp. nov. Plate XXII, figs. 3, 4 *a*, *b*, *c*.

Description.—Shell somewhat thick-discoid, consisting of about four volutions, deeply umbilicated, with a small central vacuity. The whorls increase rapidly in diameter, their section is subhexagonal. The ventral area is broad and slightly arched, the sides are flattened, and are only slightly inclined inwards, the edge of the umbilicus is subangular, its walls sloping towards the centre, thus forming an obtuse angle with the sides; the zone of impression is shallowly concave with an acute edge. The whorls in the young shell are, as usual, somewhat rounded, and do not assume the angular form of the sides until after the first whorl has been reached. The body-chamber (not quite complete anteriorly in the only specimen which shows it) occupies perhaps rather more than half a volution. It increases very rapidly in diameter, the width at the base of the cast being about 25 mm., measured across the ventral area; that at the apertural extremity being about 35 mm. in the same relative position.

The margin of the ventral area, as seen in the cast, projects outwards on each side of the body-chamber, in the vicinity of the aperture; a sensible contraction taking place in front of the projections, and a marked thickening of the test, causing an elevation in its surface, is seen just below the cast of one of these projections on the angular border of the umbilicus.

The zone of impression is shallowly concave, and bordered on each side by a prominent keel; within the keels there are two fine incised lines caused by the ridges on the periphery of the whorl embraced; the lines of growth upon the latter are also distinctly reproduced.

The septation in this species cannot be completely described, as it is only seen imperfectly in the adult; the sutures are 6 mm. apart in the last two septa; in the young shell the septa are 2·5 mm. apart where the diameter of the whorl, as nearly as can be made out, is about 5·5 mm. The siphuncle is not seen.

The ornamentation is both strongly marked and very beautiful. It consists primarily of a series of ridges or keels extending from the margin of the umbilicus to that of the ventral area. These ridges, which are beautifully crenulated by the lines of growth which cross them transversely almost at a right angle, vary in strength and distance apart. There are nine of them; those of the umbilical margin, of which there are three, being the strongest, the other six becoming finer as they approach the ventral border. The widest space between the ridges is about the middle of the lateral area; on either side of this zone they are closer together. This description is drawn up from the test on the body-chamber of an adult (?) specimen; the ridges are more regularly spaced on the test of the adolescent stage. The ridge just inside the umbilical border is quite strong in the adult shell, in the adolescent it is exceedingly faint. There are four ridges on the peripheral area, viz. two on each side, near its border, the inner ones being exceedingly fine thread-like lines. These ridges are quite distinct in the young shell, but in the adult the inner ones disappear upon the body-chamber.

A marked feature in the ornamentation is the smoothness of the zone encircling the umbilical cavity below its margin and extending from thence to the suture or line of junction with the preceding whorl. I have called this zone smooth, though there is a faint ridge or flattened band encircling it in the adolescent shell, but this compared with the strong, crenulated lateral ridges may well be neglected.

Affinities.—I am not at all confident that the generic position of the present species is correctly determined; it certainly approaches nearest to *Vestinautilus* in the configuration of the whorls, and especially in the form and the ridged character of the periphery. The wide lateral areas, so strongly ridged, with the smooth, unornamented umbilical declivities are, however, features without a parallel in that genus. Naturally, the question as to what species it is most nearly related to is still more difficult to decide, as none resembles it sufficiently to warrant any strict comparison being made. The species must remain for the present isolated.

Remarks.—This very beautiful species was found at Lisbane, in the county of Limerick, associated with the species I have called *Triboloceras formosum.* Only two specimens were collected; both of them are in the Museum of Science and Art, Dublin (Collection of the Geological Survey of Ireland).

Locality.—Lisbane, county of Limerick.

VESTINAUTILUS CRASSIMARGINATUS, sp. nov. Plate XXII, figs. 5 *a*—*c*.

Description.—Shell discoid, with slowly increasing whorls, all exposed in a deep umbilical cavity having a large central vacuity. The whorls are digonous in section, the peripheral area making a broad flattish arch; the sides, which form the steeply descending umbilicus, diverge at an obtuse angle from the margin of the latter; they are somewhat inflated in the lower half and slightly concave in the upper, resembling those of *Vest. cariniferus* in this respect. The contact or inclusion of the whorls is very slight, and, so far as can be made out from a section, there is no perceptible zone of impression. Owing to this slight amount of overlapping of the whorls, part of the peripheral area is exposed in the umbilicus, the inner whorls thus making a deep channel where they abut against those that embrace them. The umbilical border is marked by a strong, rounded rim, which becomes very prominent in the adult and senile stages.

In the young shell the rim is about as prominent as it is in the adult of *Vest. cariniferus*, J. de C. Sow., and other allied species. The conical apex of the young shell is ornamented with a series of close-set, fine, longitudinal ridges, and these are crossed by minute transverse striæ, which, cutting the former, impart a beautifully crenulated appearance to this part of the shell as seen under the lens. After the first whorl is passed the spiral lines begin to widen, and those of the lower half of the whorl entirely disappear, leaving five ridges, the two lower ones being very faint, till finally they all become obsolete, leaving only the transverse lines. These are regularly arranged and very numerous, their distance apart in the adult shell being almost exactly 1 mm. From the appearance presented by one of the specimens it would seem that they imbricate, but this is not very distinctly seen. They form upon the peripheral area a very distinct and deep, backwardly directed sinus, indicating the presence of the hyponomic sinus of the aperture. On each side of the peripheral area there are three or four faint ridges in the young shell, but before the second whorl has been reached they have entirely disappeared. In a large individual in the senile stage of growth obscure folds and tubercles are developed upon the peripheral area and in one or two places upon its margin, but these are not sufficiently prominent to alter the general features of the shell.

The septation is not known, a cross-section of one of the specimens showing that it has been destroyed internally by mineral action; the presence of the test prevents the sutures from being seen externally, supposing them to have been preserved.

The siphuncle is about twice its own diameter from the peripheral margin (Pl. XXII, fig. 5 *c*).

The body-chamber is imperfect in the specimen in which it is seen (Pl. XXII, fig. 5 *a*). A very fine but distinct ridge runs along the median line of the peripheral area upon the cast of the body-chamber; no traces of this ridge are seen upon the test.

The test is rather thick, especially upon the umbilical border, where it forms the thickened rim; here it is 4 mm. thick; below the rim, that is upon the umbilical declivity, it is 2 mm. thick; this thickness reaching about halfway to the line of inclusion of the preceding whorl, in which region it is reduced to 1·5 mm.

Affinities.—I am not acquainted with any species with which this may be strictly compared, though the young shell, in which the coarse and heavy rim of the umbilical border is undeveloped, is not unlike that of *Vestinautilus cariniferus*, J. de C. Sow., and was mistaken by me for that species until I had examined the specimen more closely and had seen the characteristic ornamentation of fine transverse lines. *Vestinautilus crassimarginatus* differs from *V. cariniferus* in having much more slowly increasing whorls, and in the presence of the very strong and coarse rim bordering the umbilicus, besides the fine and regular transverse striæ covering the whole of the test.

Remarks.—The question of the generic affinities of this shell is a difficult one to settle in the absence of a sufficient number of specimens wherewith to study the stages of growth from the very young to the old shell, and their modifications. The slow increase in the diameter of the whorls, their slight inclusion, and the great width of the umbilicus resulting from these two conditions, gives the shell, at first sight, a very different aspect from that of the more typical members of the genus to which I have referred it. Nevertheless, after careful study, I consider that these differences are outweighed by the resemblances, which consist of (1) the crater-like shape of the umbilicus, (2) the general form of the whorls, and (3) the non-tuberculated umbilical rim. It is unfortunate that the septation is not to be got at, as this would have aided very much in the determination of the affinities of the fossil.

Dimensions.—The largest specimen measures 127 mm. in its greatest diameter, and 102 mm. in its smallest. The specimen is thus elliptic: and that this form is the result of distortion by rock pressure is proved (1) by the asymmetry of the whorls both inner and outer, which do not follow the same spiral throughout their course, and (2) by the fact that in a young specimen there is no asymmetry at all. The height of the whorls relative to their width is as follows:—height, from centre of area of inclusion to centre of ventral area, 24 mm.; width, from the summit of one umbilical rim to the summit of the other, 44 mm.; thus the ratio of height to width is as 6 : 11.

I am indebted to the kindness of Prof. Grenville Cole for the loan of a specimen (the young one mentioned above) contained in the museum of the Royal College of Science for Ireland, Dublin, and from the same locality as the two full-grown specimens.

Locality.—Little Island, near Cork.

Vestinautilus cariniferus, *J. de C. Sowerby*, sp. Plates XXIII, figs. 1—3; XXVIII, figs. 2 *a*, *b*.

1825. Nautilus cariniferus, *J. de C. Sowerby*. Min. Conch., vol. v, p. 130, pl. ccccLxxxii, fig. 3 (excl. fig. 4).
? 1825. — biangulatus, *J. de C. Sowerby*. Min. Conch., vol. v, p. 84, pl. ccccLviii, fig. 2 (two figs.).
1828. — excavatus, *Fleming*. History of British Animals, p. 231.
1836. — cariniferus, *J. Phillips*. Geology of Yorkshire, pt. 2, p. 232, pl. xvii, fig. 19.
1836. — sulciferus, *J. Phillips*. Ibid., p. 232.
1844. — (Temnocheilus) cariniferus, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 20.
1855. — cariniferus, *F. M'Coy*. British Palæozoic Fossils, fasc. 3, p. 557.
1889. Cœlonautilus cariniferus, *A. H. Foord and G. C. Crick*. Geol. Mag., dec. 3, vol. vi, p. 494, figs. A to D.
1891. — — *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 112, fig. 15 A to D.
1893. Vestinautilus cariniferus, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 420.
[*Not* 1844. Nautilus cariniferus, *L. G. de Koninck*. Descrip. Anim. Foss. Terr. Carb. Belgique, p. 549, pl. xlviii, figs. 11, 12; 1878, Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. ii), pt. 1, p. 184, pl. xxviii, figs. 1—5.

Description.—Shell thick-discoid, subglobose, subhexagonal in transverse section, the whorls all exposed in a large, funnel-shaped umbilicus, which has a small central vacuity. The umbilicus is bordered in the young and adolescent stages of growth by a prominent rim or keel, which becomes gradually obsolete on the body-chamber of the adult shell. The whorls overlap so as to conceal the rim, excepting for the last half-whorl; in approaching the edge of the aperture, where the whorl narrows a little, the rim is again completely exposed (Pl. XXIII, fig. 1 *a*). The periphery of the adult shell, seen in profile, rises into a low arch which is slightly depressed in the centre; while on each side one or two faint, obtuse ridges or keels appear, and from these the periphery abruptly descends on each side to the keels bordering the umbilicus.

In the young shell very strong and prominent ventral ridges are developed, and persist for the first three whorls, when they begin to become weak and fade into the obscure ridges just described in the adult shell. These prominent ridges probably aided materially in giving firmness to the young shell, which as it became stronger absorbed them (Pl. XXIII, fig. 3).

The earlier whorls (about three of them) are distinctly inflated on the umbilical declivities, but as the shell advances towards the adult stage they become flattened and even concave in the lower half near the aperture.

The shell increases somewhat rapidly in diameter, the great lateral expansion giving rise to the deep, broadly funnel-shaped umbilicus.[1] The body-chamber occupies about half a volution; a little above its base are seen, in well-preserved casts, the impressions, consisting of pittings and other rugosities appertaining to the shell-muscle. These are admirably shown in a specimen from Cork in the collection of the British Museum (Natural History). They are figured in the 'Catalogue of the Fossil Cephalopoda,' British Museum, pt. ii, 1891, p. 106, fig. 15, where a full description of these remarkable impressions will be found. Other marks (Runzelschicht) originating in the soft parts of the animal are the singular rows of minute punctures, not unfrequently met with on casts of the body-chamber; these have a linear arrangement conforming precisely with the outline of the aperture, and are remarkably regular. The surface of the test is perfectly smooth, only fine striæ of growth being seen when it is suitably preserved.[2]

The septa are very numerous; upon the umbilical declivities the sutures are arched slightly backwards, and form in crossing the periphery a shallow, backwardly directed sinus; they increase slowly in their distance apart. Where the periphery measures 30 mm. in width they are 5 mm. apart, and this distance is increased to 8 mm. where the periphery is 45 mm. wide (Pl. XXIII, fig. 2).

The siphuncle is situated a little above the centre of the septum in the adult shell, but its position probably varies somewhat in the course of shell-growth.

The surface of the specimens that I have examined, and they are many, exhibit no markings except what may be described as lines of growth; but, as I have remarked in the description of *V. paucicarinatus*, this negative evidence must not be taken as conclusive, because mineral action in these fossils, though leaving a smooth and apparently uninjured surface, may have, as in the instance referred to, completely destroyed all surface markings not coarse enough to withstand it.

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[1] The gigantic individual, whose dimensions are given on the next page, was presented to the Museum of Science and Art, Dublin, by Mr. Thomas Plunkett, M.R.I.A., of Enniskillen, an ardent geologist and archæologist.

[2] A specimen, apparently belonging to this species, from Glenbane, county of Limerick, shows two strong and prominent folds near the aperture on each side. Through an oversight, this specimen has not been figured in its proper place. It is figured in Pl. XXVIII.

Dimensions.

	Specimen from Clane of ordinary size.	Large specimen from Enniskillen.
Diameter of shell	93 mm.	190 mm.
Height of outer whorl	33 „	66 „
Diameter of penultimate whorl from suture to suture	35 „	95 „

Affinities.—Attention is drawn under the description of ***Vestinautilus crateriformis*** to the resemblances between that species and the present one, which therefore need not be here recapitulated. Another allied form is ***V. paucicarinatus***, the ventral and lateral ridges in which are a distinguishing mark separating it readily from the present species, which except in the young shell (and according to Hyatt[1] in the adolescent also) are not developed or very feebly so. There is never any lateral or umbilical ridge or keel in ***V. cariniferus***.

Remarks.—This species belongs to the group of crateriform and keeled shells which Professor Hyatt has marked off from ***Cœlonautilus*** and assigned to de Ryckholt's genus ***Vestinautilus***,[2] a change which I have accepted.

The present species appears to be one of the most abundant as well as widespread in the Carboniferous limestone of Ireland. It seems to be much less common in England.

Localities.—Clane, county of Kildare; near Enniskillen, county of Fermanagh (the largest specimen known); Little Island, near Cork; Rathkeale and Ardtomin, county of Limerick.

VESTINAUTILUS CARINIFERUS, *J. de C. Sowerby*, sp. Var. ***magnicameratus***, nov.

Plate XXI, fig. 8.

The presence of a species or variety closely allied to ***Vestinautilus cariniferus*** has often suggested itself to me when looking over any large series of specimens assumed to belong to this species.

I have before me a specimen which, if the septa were not exposed to view, might easily be mistaken for Sowerby's species; their wide separation, however, is a feature which cannot be overlooked, and one which entitles this form to at least varietal rank. I therefore propose for it the name ***magnicameratus*** as expressing its chief characteristic.

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[1] "Carboniferous Cephalopods." Second paper. 'Geological Survey of Texas, Fourth Annual Report,' 1892, p. 420.

[2] 'Notice sur les genres Nautilus, Vestinautilus, &c.,' de Ryckholt, 1852.

The specimen before me is much distorted, and part of the body-chamber is wanting. The umbilicus on one side is partly clear of the matrix, so that it reveals a portion of the penultimate whorl. Only part of the test is present, but there is sufficient to show that the keel bordering the umbilicus is not well defined, and that it becomes obsolete on reaching the body-chamber, the shell becoming more and more broadly rounded on the umbilical margin as the region of the aperture is approached. The outlines of the sutures of the septa are irregular owing to the crushing the shell has been subjected to, but it can be seen that they formed a shallow sinus in the median line of the periphery. The distance of the septa from each other in the latter position is 10 mm., close to the base of the body-chamber; the fourth and fifth, counting from the latter, measuring 9 mm., the seventh and eighth 7·5 mm. (cf. *V. cariniferus*, Pl. XXIII, fig. 2).

Dimensions.

	Specimen in Museum of Science and Art, Dublin.
Diameter of shell (approximate) . . .	. 73 mm.
Width of umbilicus, about . . .	. 52 ,,
,, periphery . . .	. 52 ,,
Height of outer whorl . . .	. 32 ,,

Locality.—Limerick (? near the city).

VESTINAUTILUS CRATERIFORMIS, sp. nov. Plate XXIII, figs. 4 *a*—*c*.

Shell thick-discoid, subglobose, transversely subquadrate in section, the whorls all exposed in a deep, broadly crateriform umbilicus having a small central vacuity. The margin of the umbilicus, which is very acute in the cast, was, judging by a remnant of the test, apparently slightly keeled. The whorls overlap to the edge of the umbilical margin of the preceding whorls, leaving only an incised line to mark the place of this margin on the steep crater-like side of the umbilicus. The umbilical slopes are somewhat inflated, as in *V. cariniferus*. The peripheral area presents a low and broad arch which slopes a little more abruptly near the umbilical margin; faint traces of keels, one on each side of the latter, are seen upon the well-preserved fragment of the test still remaining; these keels are perceptible also upon the cast.

The body-chamber is imperfect, and is only a cast with fragments of the test adhering. On separating it from the septate part of the shell the position of the siphuncle is seen to be a little above the centre of the septum. The septa, the sutures of which are clearly exposed on the cast, are somewhat shallow; the sutures form upon the umbilical slopes a series of curves, with the concavities directed forwards. Upon the peripheral area they sweep from side to side in a broad and shallow backwardly directed sinus. Their distance apart is very slowly augmented; where the transverse diameter of the peripheral area measures 30 mm. they are 7 mm. apart, this distance being increased to 10 mm. where the diameter is 45 mm. It will thus be noticed that they are wider apart than those of *V. cariniferus*, the form most nearly allied to the present one. There is a well-marked annular lobe (Pl. XXIII, fig. 4 *c*).

The surface of the test is seen, even where it is somewhat eroded, to be covered with fine, rather regular, transverse striæ of growth, and on the portion of the test preserved on the peripheral area, numerous faint, longitudinal striæ are visible, with here and there a backwardly directed sinus marking the form of this part of the aperture.

Affinities.—This species is very closely allied to *V. cariniferus*, J. de C. Sow., the differences separating the two forms being the following : the peripheral area is flatter and also broader than in *V. cariniferus*, the latter feature causing the sides of the umbilicus to be steeper than in that species. The septa, as has been shown, are wider apart in the present species than they are in Sowerby's ; hence it seemed justifiable to give the former a distinct name.

Remarks.—I am only acquainted at present with one specimen of this species, but its characters are well marked, and its recognition will thus be readily secured should other individuals be found.

Locality.—Rathkeale, county of Limerick.

VESTINAUTILUS PAUCICARINATUS, *A. H. Foord.* Plate XXIV, figs. 1—5.

1825. NAUTILUS MULTICARINATUS, *J. de C. Sowerby.* Min. Conch., vol. v, p. 129, pl. cccclxxxii, fig. 2 (excl. fig. 1).

1878. — CARINIFERUS, *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, Paléont., tom. ii), pt. 1, p. 134, pl. xxviii, figs. 1—5 (*not* of J. de C. Sowerby).

1891. CŒLONAUTILUS PAUCICARINATUS, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 2, p. 116, fig. 17.

1893. VESTINAUTILUS PAUCICARINATUS, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 420.

Description.—Shell thick-discoid, composed of three volutions which increase rapidly in diameter and are exposed in a deep, funnel-shaped umbilicus, having a small central vacuity. The whorl is trapezoidal in transverse section; in a more detailed view it is seen to be decagonal,—that is, it is made up of ten surfaces and angles. The peripheral area is broadly arched in general outline, but it presents, when more closely examined, three zones, the centre of which may be slightly concave; this is bordered by the two lateral zones, which descend rapidly to the umbilical margin. The umbilical declivity is again divided into two tolerably distinct areas (at least until the aperture is nearly reached); the upper, which is much the narrower, being the space marked off by the inner and outer keels of the shell; the lower comprising the space between the inner keel and the line of junction of the whorls. The remaining area is the impressed zone which, in the present species, is divided into three rather obscurely defined zones corresponding with those of the peripheral area which it embraces in the young shell. The overlapping or inclusion of the whorls extends to the umbilical marginal keel in the young shell, but in the adult it sometimes, though not always, leaves this keel free for the last half-whorl. The umbilical slopes are very slightly inflated below the inner keel; the whorl in the proximity of the body-chamber becoming also distinctly rounded on the umbilical shoulders, owing to the dying off of the keels bordering and just inside the umbilicus. The principal keels are those here referred to, the marginal one being the strongest, and resembling, in every respect, the one occupying the same position in *V. cariniferus*. It borders the umbilicus, which it completely encircles, dying off gradually as the body-chamber is reached. The inner keel is much less prominent than the outer one, to which it is approximate and parallel; it generally extends to within a very short distance from the aperture. The peripheral are generally much less conspicuous and prominent than the umbilical keels, and in some species they almost entirely disappear in the adult shell. Typically there are three on each side of the more or less flattened central zone of the peripheral area, the inner one being much less distinct than the outer ones. In the specimen figured (Pl. XXIV, fig. 1 *b*) these ventral keels are remarkably well developed. They are, in general, equidistant, the distance of the outer one from the umbilical keel being slightly greater than that separating them from each other. They are generally to be seen faintly on casts (Pl. XXIV, fig. 2).

The septa in this species are approximate, their distance from each other varying from 6·5 mm. to 8·5 mm. measured on a cast in the median line of the peripheral area (Pl. XXIV, fig. 2), the width of which is here from 50 mm. to 55 mm. The sutures have a curvature on the umbilical slopes of which the concavity is directed anteriorly. On the peripheral area they make the figure of a bent bow, the principal curvature of which has its concavity or sinus directed towards the aperture, as is always the case. There is an annular lobe (Little Island specimen).

The siphuncle, as seen in a polished section (Pl. XXIV, fig. 3) and in a distorted specimen from Little Island, is situated about its own diameter above the centre, its position remaining tolerably constant throughout the entire growth of the shell.

The surface of the test has hitherto been described as smooth, but a specimen from St. Doulagh's, in which the test is in a remarkably perfect state of preservation, shows a series of fine but very distinct longitudinal striæ covering it (cf. de Kon., 'Calc. Carb.,' pl. xxviii, fig. 3 *d*). These are indistinctly seen on another specimen with the aid of a lens; they would probably have escaped my observation had not their presence in the first-named specimen led me to make a careful search on others for similar markings. Crossing the keels bordering and within the umbilicus there is, at regular intervals, a series of minute but very distinct crenulations caused by a thickening of the lines of growth.

The perfect smoothness of the surface of the test—that is, the total absence of any markings, even of the most minute description—in most of these fossils is probably due to mineral action, which, in the slow process of fossilisation, completely replaced the original substance of the shell by calcite or by some form of that mineral (perhaps aragonite), obliterating all but the coarser markings. That this was not always the case, however, we see proofs in the presence of the minute surface markings described above, as well as under *Vestinautilus pinguis*.

In addition to these striæ there are transverse ones which are to be regarded as lines of growth, as they follow the contour of the whorls, and form upon the peripheral area the deep, backward bend which indicates the presence of the hyponomic sinus at the aperture. These lines are sometimes, though extremely fine, remarkably regular, so as almost to raise them to the rank of ornamentation; they become very crowded close to the aperture; before this point is attained about eight may be counted in the space occupied by 6 mm.

Affinities.—The general resemblance of this shell to *V. cariniferus* is sufficiently obvious and has already been dwelt upon; it differs from it chiefly in the presence of the inner keel of the umbilicus, in its wider septation, in having three more or less distinct keels on the peripheral area, and, perhaps may be added, the fine longitudinal striation recently observed, a feature, however, which *V. cariniferus* may yet be discovered to possess.

Remarks.—This is a very common species both in the Dublin district, with which I am best acquainted, and, apparently, in other parts of Ireland. De Koninck refers to it (under the name of *Nautilus cariniferus*) as being tolerably abundant at Pauquys, Dréhance, and Anseremme, in Belgium.

Localities.—St. Doulagh's, county of Dublin (common); Clane, county of

Kildare; Cork (near the city, but exact locality unknown; probably Blackrock); Little Island, near Cork.

VESTINAUTILUS PINGUIS, *L. G. de Koninck*, sp. Plate XXV, figs. 3 *a*, *b*.

1844. **NAUTILUS PINGUIS**, *L. G. de Koninck*. Descrip. Anim. Foss. Terr. Carb. Belgique, p. 551, pl. xlviii, fig. 10 (*not* of M'Coy).

1878. — — *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. ii), pt. 1, p. 136, pl. xxx, figs. 6, 7.

1891. **CŒLONAUTILUS PINGUIS**, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 117, fig. 18.

1893. **VESTINAUTILUS PINGUIS**, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 420.

Description.—Shell thick-discoid, composed of about three slightly embracing volutions, the sides of which are exposed in a deep, funnel-shaped umbilicus, with a central vacuity of moderate size. The whorls increase somewhat rapidly in their dimensions, their section in the adult is trapezoidal and decagonal. The periphery is very broad, and, compared with the height of the whorls, dorso-ventrally, as 22 : 37; it is divided into three areas, the median one the broader, two narrower areas on each side of it descending abruptly to the umbilical margin; the median area may be slightly depressed in the centre. The lateral area is represented only by a narrow zone, sloping inwards a little, bounded above by the keel bordering the umbilicus, and below by the second keel within the latter. The umbilical declivities are inflated considerably both in the young and in the adult shell.

The body-chamber occupies about one half of the last whorl.

The septa are moderately distant; thus, where the width of the peripheral area is 40 mm. they are 10 mm. apart, where the width is 31 mm. they are 7 mm. apart. Their course is tortuous; beginning at the suture-line of the penultimate whorl, they are bent slightly backward, and again upon the lateral zone; then, in crossing the periphery upon the area sloping upwards to the median zone, they arch forwards, making a broad, backwardly directed sinus on the median zone itself.

The siphuncle is not seen in the Irish specimens that have come under my notice, but de Koninck describes its position as being within the upper third of the septa.

The ornamentation is very conspicuous. It consists of prominent keels strong enough to leave their impression distinctly upon the cast. The first whorl, for about half its length, has fine longitudinal ridges, one of which is continuous and forms the inner keel of the umbilicus. At the commencement of the second whorl the periphery bears on each side of the median area two keels, which gradually become obsolete, sometimes near the base of the body-chamber, where they may be represented merely by faint, slightly raised lines, sometimes extending nearer to the aperture. The periphery, losing the keels, here becomes rounded at the umbilical angles.

The two keels encircling the whorls are finely crenulated, at least up to the termination of the first whorl, and often as far as the extremity of the second, after which the crenulations disappear and the keels become simple.

The test, when suitably preserved, is seen to be covered with fine transverse lines of growth; of these lines, stronger ones occur at regular intervals and develop slight nodes in crossing the umbilical keels, thus giving rise to the beautiful crenulations just described. These crenulations do not appear to be developed upon the peripheral keels. Extremely fine lines, taking a longitudinal direction, cover the lines of growth; these are irregular and minutely tortuous in their course, and of silky fineness. They can be seen only with the aid of a lens.

The rarity of the preservation of such ornaments as these latter is probably due to the abrasion which the dead shell undergoes on the sea-bottom before being covered by the protecting mud. In some cases, perhaps in the majority of them, mineral or chemical action has probably operated in the obliteration of such delicate markings, when the deposit in which the fossils were entombed had become consolidated into rock.

Affinities.—The close resemblance between this species and *V. paucicarinatus*, Foord, is obvious upon comparing the figures of them (Pl. XXIV, and Pl. XXV, figs. 3 *a*, *b*); it would be scarcely possible to distinguish between them without the septa being exposed to view.

On comparing the septation of the present species with that of *V. paucicarinatus*, it is found that it is much closer in the latter species, in which the septa vary from 6·5 mm. to 8·5 mm., where the width of the peripheral area is from 50 mm. to 55 mm. It has just been stated that the septa in *V. pinguis* are 10 mm. apart where the width of the peripheral area is 40 mm. There is thus a very great difference in this respect between the two species.

Another feature in which *V. pinguis* differs from *V. paucicarinatus* is in the absence of the annular lobe conspicuous in the last-named species (cf. de Kon., 'Calc. Carb.,' *loc. cit.*, pl. xxviii, figs. 5 *a*, *b*; pl. xxx, fig. 6 *c*).

Remarks.—I have seen very few specimens of this species which could be identified as such, but, as I have already indicated, the presence of the test would render its identification difficult, if not impracticable; therefore some specimens may have been passed over or mistaken for *V. paucicarinatus*, with which it is found associated.

Locality.—Limerick (probably near the city).

VESTINAUTILUS SEMIPLICATUS, sp. nov. Plate XXV, figs. 1 *a*, *b*, 2 *a*, *b*.

Description.—Shell thick-discoid, of a robust habit, consisting of about four volutions, all exposed in a deep umbilical cavity having very steep sides. The whorls increase rather slowly in diameter, and their section is roughly decagonal; the peripheral area being more raised in the centre than at the sides, thus forming an irregular arch. The edge of the umbilicus is angular in the specimen before me (the only one known to me), and there is no rim or keel properly so called; a prominent one, however, is present within the umbilicus at a very slightly lower level than the margin of the latter, and hence forming a sort of platform, from the inner edge of which there is a steep slope down to the suture of the preceding whorl. Beginning at about the last half of the last volution the angularity of the whorl disappears, and at the same time the keel at the umbilical shoulders becomes plain and rounded. Just at the commencement of the body-chamber, on either side two large folds make their appearance; these are succeeded by another rather stronger pair, and these again (on the cast) by a pair of prominent tubercular folds which formed the outer boundaries of a former aperture, the hyponomic sinus of which is indistinctly seen on the cast in continuation of these folds. Two other pairs of prominent tubercular folds occur, the last of which formed the edge of the present aperture of the shell, the margin of which can be traced in the cast with its broad and deep hyponomic sinus. The body-chamber does not exceed half the length of the last volution. The septa and siphuncle are not known, as the test completely covers the septate part of the shell. There are no surface ornaments, but lines of growth which mark the form of the hyponomic sinus, already described, are seen at different places on the peripheral area; and, conforming in direction with these lines, there are also coarse and inconspicuous folds. Two faint ridges appear on each side of the peripheral area at its narrowest part; these were probably stronger in the young shell.

Dimensions.

	Unique specimen, from Rathkeale.
Diameter of shell	115 mm.
,, umbilicus (from edge to edge) . .	80 ,,
,, ,, (from suture to suture) .	45 ,,
Height of outer whorl (dorso-ventral) . .	47 ,,
Thickness at umbilical margin . . .	70 ,,
Width of periphery of outer whorl . . .	67 ,,

Affinities.—These are to all appearance with *V. paucicarinatus*, but in the absence of the septa they cannot be very well discussed. There are, however, very decided differences between the two species, firstly, in the dimensions of the peripheral area, which is much narrower in the present species than in *V. paucicarinatus*, and again in the height of the whorl, less dorso-ventrally in the former species than in the latter, these features resulting in a much shallower umbilicus; secondly, in the character of the area formed by the umbilical margin and the inner keel of the latter, as already described (cf. Pl. XXIV, figs. 1 *a*, *b*). The young individual figured upon Pl. XXV (figs. 2 *a*, *b*) has some points of resemblance with *V. semiplicatus* which cannot be overlooked; these are principally in the umbilical characters. Each has the shelf-like level area included in the space between the edges of the umbilicus strongly keeled in the young shell (cf. fig. 2 *a*) and the inner keel. No comparison can be made of the features presented by the peripheral area, as this is seen only in the senile stage of growth in *V. semiplicatus*. They are very strongly marked in the young individual, consisting of two deep and conspicuous sulci bordering the central zone, flanked upon the outside by two keels or ridges, the inner one, or that bordering the sulcus, being much stronger than the outer one. The central zone, which is slightly concave, is ridged on each side, the ridges, which are but slightly raised, forming the inner boundary of the sulcus on each side. Judging from numerous specimens of adult shells of *Vestinautilus*, it is probable that these conspicuous ridges and sulci do not persist, but that they become gradually obsolete as the shell progresses towards the adult stage.

Remarks.—The conspicuous tubercular folds upon the body-chamber of the present species would appear to be a senile character, the shell described showing signs in the coarse and rugose appearance of its surface that it has reached an advanced stage of growth. From the fact that only one specimen of this species has been obtained up to the present time it must not be too readily assumed that it is a rare one. The search on the occasion upon which the individual here described was obtained was too limited to justify any such conclusion. This part of the country has not had such attention bestowed upon it as the very interesting nature of some of the material already collected there ought to arouse. I hope something may be done before long to work up the fossil fauna of these rich south-western counties. The chief obstacle is the want of any local interest in the subject.

Locality.—Rathkeale, near Limerick.

VESTINAUTILUS MULTICARINATUS, *J. de C. Sowerby*, sp. Plate XXV, figs. 4 *a*, *b*, 5.

1825.	NAUTILUS MULTICARINATUS, *J. de C. Sowerby*. Min. Conch., vol. v, p. 129, pl. ccccdxxxii, fig. 1 (excl. fig. 2).
1836.	— — *J. Phillips*. Geology of Yorkshire, pt. 2, p. 232.
1843.	— — *J. E. Portlock*. Geology of Londonderry, p. 405.
1844.	— (TEMNOCHEILUS) PORCATUS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 22, pl. iii, fig. 6.
1860.	TEMNOCHEILUS MULTICARINATUS, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 57.
1878.	NAUTILUS MULTICARINATUS, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, Paléont., tom. ii), pt. 1, p. 121, pl. xxv, figs. 2 *a*—*c*.
1891.	CŒLONAUTILUS MULTICARINATUS, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 114, fig. 16.
1893.	VESTINAUTILUS MULTICARINATUS, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 420.

Description.—Shell thick-discoid, composed of two and a half or three volutions, the sides of which are completely exposed in a deep, funnel-shaped umbilicus having a small, central vacuity. The whorls increase rapidly in diameter, the peripheral area projecting laterally and thereby greatly overhanging the dorsal or antiperipheral area. The zone of impression is distinct, its boundaries being those of the periphery. The section is subhexagonal in outline, the sides being represented by a very narrow zone bounded by strong keels. The periphery is broadly and tolerably evenly rounded, and is divided in all stages of growth into two distinct elevations by a narrow, median furrow; these elevations are highest on each side of and near to the furrow, from whence they slope abruptly down to the umbilical margin. Here the narrow zone, referred to above, occurs, and from this the steep declivities of the umbilicus, slightly inflated in their lower third, fall to the edge of the suture of the shell. It is to be observed that the lateral or narrow zone, as I have called it, is proportionately wider in the young and adolescent stages (*i. e.* in individuals measuring respectively 20 mm. and 45 mm. in diameter) than in the adult (?) shell (75 mm. in diameter).[1]

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[1] It is not absolutely certain that the individuals of this species known up to the present time are in the adult stage of their growth, or that there may not be found much larger individuals than

The apical part of the initial whorl, exposed in a young individual by breaking away the enveloping whorl, has a very slight curvature, the succeeding volution completely covering its peripheral area. It is depressed dorso-ventrally like the adult shell, which it resembles in miniature; it expands rapidly; the apex is scarcely 1 mm. in its lateral diameter; at a distance of 7 mm. this has increased to 3·5 mm. The lateral areas are circumscribed, as in the adult shell, by two ridges which are much more prominent than the others; the dorsal area is evenly and gently rounded, its surface is ornamented with nine or ten fine but distinct ridges, which are crossed by minute lines of growth. The ridges do not cover the extreme apex, which is apparently smooth (Pl. XXV, fig. 5). They increase rapidly in strength and prominence as they advance from the apex.

The septa in this species are very numerous; the sutures are 5·5 mm. apart upon the periphery, where the width of the latter is 30 mm. Their course conforms in its direction to the shape of the periphery; upon the two elevations they curve gently forwards and form a backwardly directed, shallow sinus in crossing the median furrow. Upon the narrow lateral zones they curve slightly backwards, taking the same direction on the umbilical declivities.

The siphuncle is a little below the centre of the septum.

The ornamentation, remarkably well developed in this species, consists of strong, prominent, rounded, longitudinal ridges or keels covering the peripheral area and bordering the lateral zones, but obsolete upon the umbilical declivities. Five of these ridges occupy the elevated areas on each side of the median furrow on the periphery; the outermost of them forms the upper boundary of the very narrow lateral zone, the lower boundary of which is constituted by the ridge which forms the edge of the umbilicus. A ridge, much less prominent than any of the others, occurs near the summit of the umbilical declivity just beneath the keel bordering the latter. This supplementary ridge is present in all stages of the growth of the shell, beginning with the initial innermost whorl. Though resulting from a vertical thickening of the test, the ridges nevertheless leave distinct elevations upon the cast. They are divided upon the periphery by spaces of about their own width, but a slightly greater space separates the outermost keel from the one bordering the umbilicus, this space being what I have called the lateral zone, whose plane is at right angles to that of the periphery. The

any that have yet been described, as has proved to be the case with *Vestinautilus cariniferus* (see above, p. 84). Signs of the adult stage are generally to be discerned in some modification of the ornaments of the test, which on the one hand may become coarser, or on the other obsolete or nearly so; the latter condition usually indicating the senile, or, to use Professor Hyatt's expression in its broader sense, gerontic stage. It must be observed that these signs of maturity are not present in the individual whose diameter I have given above, which is, moreover, broken anteriorly; hence the query.

outermost keel of the periphery is always thicker than any of the others, and this in all stages of growth of the shell.

The surface of the test is covered with fine transverse lines of growth, broadly sinuous on the periphery.

Affinities.—The present species most nearly resembles *Vestinautilus paucicarinatus*, A. H. Foord, from which it differs in its numerous keels and in its very narrow lateral zone. From *V. pinguis*, L. G. de Koninck, it is distinguished by the first of these characters and by its much closer septa.

Remarks.—"The specimens belonging to this species in the British Museum Collection prove conclusively that the number of keels does not depend upon the age of the shell, as supposed by Sowerby ('Min. Conch.,' loc. cit.), and that the latter included under the name *multicarinatus* two distinct types."[1] One of these, viz. that having the richly keeled peripheral area, was chosen by de Koninck (loc. cit.) as the type of *multicarinatus;* to the other I gave the name *paucicarinatus.*[2]

The fragment now before me, described by M'Coy under the name of *Nautilus* (*Temnocheilus*) *porcatus,* has long been recognised as belonging to the present species. Both d'Orbigny[3] and Giebel[4] make this observation, though they neither of them noticed that Sowerby had blended two distinct forms under one name.

The fragment in question is a cast of a portion of the body-chamber of a small individual. The specimen measures 30 mm. in length and 20 mm. in its greatest breadth. The characteristic ridges and median furrow are well preserved, and leave no doubt as to the identity of the fossil, which was obtained in the Carboniferous shale at Townparks, Killeshandra, county of Cavan. It is in the "Griffith Collection" of the Science and Art Museum, Dublin.

Finally, Phillips[5] recorded a species under the name *multicarinatus*, Sow., from Cork and Cumberland, possessing many ridges and furrows, which may also be referred, without much hesitation, to the present species.

Localities.—Kildare, Cork (the counties only can be given); Townparks, Killeshandra, county of Cavan.

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[1] 'Cat. Foss. Ceph. British Museum,' pt. 2, 1891, p. 115.

[2] Loc. cit., p. 116.

[3] 'Prodrome de Paléontologie Stratigraphique,' vol. i, p. 110.

[4] 'Fauna der Vorwelt,' Band iii, Abth. 1, p. 174.

[5] Loc. cit.

Genus PLANETOCERAS, *Hyatt*, 1893.

PLANETOCERAS GLOBATUM, *J. de C. Sowerby*, sp. Plate XIX, figs. 5 *a*, *b*, 6.

1821. NAUTILUS GLOBATUS, *J. de C. Sowerby*. Min. Conch., vol. v, p. 129, pl. ccccLxxxi.
1844. — (TEMNOCHEILUS) GLOBATUS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 21.
1860. TEMNOCHEILUS GLOBATUS, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 77.
1891. CŒLONAUTILUS GLOBATUS, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 127, fig. 20.
1898. PLANETOCERAS GLOBATUM, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 421.

Description.—Shell subglobose, consisting of about two and a half volutions, the inner ones exposed in a very deep umbilicus with almost vertical sides and a central vacuity of moderate size. The shell increases rapidly. The apex is conical. The periphery is flattened in the young shell, and there is a distinct angle at the edge of the umbilical vacuity which persists to the completion of about one and a half volutions, where it develops into a strong keel which is slightly inflected, so that its edge faces the umbilicus. The periphery, flattened in the young shell, becomes rounded in the adolescent and adult stages, but it tends towards the aperture to be again somewhat depressed. The last whorl, by its lateral expansion and the depression of the peripheral area in approaching the aperture, assumes a laterally spreading form, with a very wide, dorso-ventrally contracted aperture.

Near the aperture the body-chamber frees itself from the penultimate whorl and arches upwards tangentially to the original coil.

The aperture has a somewhat broad hyponomic sinus, on each side of which two broadly rounded lobes or "crests" project. At the angles just below the keel there is a slight notch or wave in one of the specimens before me, but the line of the aperture connecting these points has not been seen.

The body-chamber occupies half of the last whorl.

The septa are rather approximate, their distance in a young shell being about one fifth of the dorso-ventral diameter.

The siphuncle is nearly central.

The surface of the test is smooth, only extremely fine lines of growth being seen when it is well preserved. In a young and almost complete specimen, in which the test is in some places preserved in a state of perfection rarely seen in fossils, there are exceedingly delicate longitudinal, apparently incised lines crossing the lines of growth (Pl. XIX, fig. 5).

Dimensions.

	Adult individual (Mus. Science and Art, Dublin).	Young individual.
Diameter of shell (exclusive of free portion) . . .	92 mm.	45 mm.
Height of outer whorl . . .	45 ,,	20 ,,
Width of umbilicus . . .	28 ,,	15 ,,

Affinities.—As I am acquainted with actual specimens of only one species—the one just described—I can say nothing under this head from personal knowledge. Professor Hyatt[1] describes a new species under the name of *Planetoceras retardatum*, which he compares with *P. globatum.* He says: "This (*P. retardatum*) has the same outline to the aperture as in *globatum*, and a similar living chamber, but is much smaller, and the whorls are not so stout or broad in proportion. The ephebic (adult or mature) stage has, however, been fully attained, as is shown by the rounded lateral zones of the whorls and the uncoiled character of the outer part of the living chamber."

I think I was in error in assigning *Nautilus atlantoideus*, de Koninck, to the present species,[2] and I accept Professor Hyatt's correction when he says that *N. atlantoideus* "differs too much in the development of the young, if figured correctly by de Koninck, to be considered identical with *P. globatum.*"[3]

Remarks.—The remarkable laterally expanded and contracted form of the free portion of the body-chamber in this species differentiates it from all other Nautiloid shells of the Carboniferous rocks, the immature as well as the adult shell exhibiting these features in an almost equally marked degree.

This is a very common shell at St. Doulagh's, scarcely any series of fossils from the quarries there being without specimens of it.

Localities.—St. Doulagh's, county of Dublin; "Kildare" (probably Clane). Doneraile, county of Cork (*fide* Sir R. Griffith, in his list of localities appended to M'Coy's 'Synopsis,' 1862 issue).

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[1] "Carboniferous Cephalopods." Second paper. 'Geological Survey of Texas, Fourth Annual Report,' 1892, p. 421.

[2] 'Cat. Foss. Ceph. British Museum,' pt. 2, 1891, p. 128.

[3] Loc. cit., p. 422.

Family Rineceratidæ.

Genus Thrincoceras, *Hyatt*, 1893.

Thrincoceras Hyatti, sp. nov. Plate XXVI, figs. 1 *a*—*g*.

Description.—Shell discoid, compressed, composed of nearly three whorls, the sides of which are entirely exposed in a shallow umbilicus having a small, central vacuity.

The whorls increase rather slowly in diameter, the last one in the adult shell becoming detached from the preceding one for a short distance. The body-chamber occupies about half a volution. The section is subquadrangular and hexagonal; the peripheral area is depressed but somewhat convex; the sides are flattened and converge from the umbilical angle towards the periphery. The umbilical slopes in the adult shell are moderately steep, the angle connecting them with the sides not distinctly defined. There is no distinction in the young shell between the sides and the umbilical slopes, the whorls being there evenly rounded. The peripheral area in the adult, on the other hand, is separated from the sides by a well-defined angle, but whether this is the case in the young shell I have no means of judging, as that part of the shell is covered up by the later volutions in the specimens available for study.

The impressed zone, which is shallow, is marked out by obscure, rounded elevations (Pl. XXVI, fig. 1 *c*). The presence of this zone indicates, in the young shell, a slight median elevation which is less distinct in the adult.

The septa are moderately distant; where the diameter of the whorl is 15 mm. they are 5 mm. apart upon the sides of the shell, and this distance scarcely varies in the entire whorl, the diameter of which is 63 mm. The sutures form a somewhat deep, backwardly directed lobe upon the sides, cross the umbilical margin with an acute angle, and form a rather shallow sinus upon the periphery.

The siphuncle, as seen in the young shell, is a little above the centre of the septum (Pl. XXVI, fig. 1 *g*).

The ornamentation of this species is very elaborate. The test is completely covered with fine, acute, longitudinal ridges; in the adult shell these are widest apart upon the umbilical declivities, where there are five or six upon the last whorl; on the sides they become closer, about twelve may here be counted; upon the periphery they are still finer, there being sixteen or seventeen, of which four or five are crowded together on each side of the median zone, where there are six more widely spaced ones. The ridges are developed also upon the impressed

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[illegible]	[illegible]	[illegible]	men from St. Doulagh's, e Museum of the Royal llege of Science, Dublin.
[illegible]	[illegible]	[illegible]	90 mm.
[illegible]	[illegible]	[illegible]	43 ,,
[illegible]	[illegible]	[illegible]	35 ,,
[illegible]	[illegible]	[illegible]	28 ,,
[illegible]	[illegible]	[illegible]	30 ,,
[illegible]	[illegible]	[illegible]	20 ,,

[illegible] he relationship subsisting between
[illegible] ecies. As it was in studying *T. Hyatti*
[illegible] genus *Thrincoceras* was represented in
[illegible] turally be supposed that *T. Hyatti* should
[illegible] American species described by Hyatt, which
[illegible] pecies of *Thrincoceras* described by Hyatt,[1] that
[illegible] *as Kentuckiense* is the most strictly comparable
[illegible] eglecting the superior dimensions of the American
[illegible] of 170 mm. against 90 mm. in the largest Irish shell
[illegible] nces between the two are such as easily catch the eye,
[illegible] y rough figures given in the 'Geology of Texas,' I was at
[illegible] em when the fossil, here under description, came under my
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[illegible] yatt's specimens appear to have been poorly preserved, as is
[illegible] ne of the figures he gives of *T. Kentuckiense*, which is a cast showing

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[1] [illegible] iferous Cephalopods." Second paper. 'Geological Survey of Texas,' 1893. Reprinted [illegible] nnual Report, 1892, pp. 430—434.

no vestige of the ornaments of the shell (loc. cit., figs. 11, 12). He describes the umbilical perforation in this species as "very large," though "the size could not be exactly ascertained, owing to the breaking out of part of the youngest whorl." In *T. Hyatti*, as indicated above, the central vacuity of the umbilicus is *small.* I observe, however, that in *T. Kentuckiense* the central vacuity is represented in one of the specimens figured (fig. 12) as very much smaller than in another (fig. 14). Thus fig. 12 represents a shell resembling *T. Hyatti*, in this respect, as closely as need be.

Professor Hyatt does not describe the ornamentation of *T. Kentuckiense* in detail, but he refers to the figure of another species (*T. depressum*), the ornamentation of which is presumably essentially similar to that of the first-named species. In his description of *T. depressum* he says: "The larger ridges have fine longitudinal ridges between them, and in the later stages these become more prominent and visible to the naked eye. There are usually three or four of these between each pair of large ridges on the umbilical zone, where alone they were observed, the condition of the shell elsewhere not permitting them to be seen. Between each pair of these secondary ridges there appears, under the magnifier, a third series of single longitudinal lines. Sometimes these three kinds of ridges were all of the same size in the shell examined, so that it was difficult to decide whether they did not all belong to the same system. The longitudinal system of ridges are crossed by obscure striæ of growth visible only under a magnifier in this shell."

The ornamentation here described agrees perfectly with that of the present species, except that the interstitial ridges are more numerous in Hyatt's species than in the latter, a difference which may well be due to the much larger size of the Texan forms admitting of such additions. As regards the septation, the backwardly directed sinus upon the peripheral area in *T. Kentuckiense* is much deeper than in *T. Hyatti*. It may be here mentioned also that the outline of the periphery is more rounded in the former species than in the latter.

Remarks.—The most striking feature in the present species is the beautiful system of ridges which so completely covers, while it ornaments, the shell. By means of the sculpture the most imperfect specimens of this species may be recognised, its characteristic appearance appealing at once to the eye.

Locality.—St. Doulagh's, county of Dublin.

Thrincoceras Hibernicum, *A. H. Foord*, sp. Plate XXVI, figs. 2 *a*, *b*.

1891. Gyroceras Hibernicum, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 64, fig. 5.

1893. Rineceras Hibernicum, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 425.

Description.—Shell discoid, composed of two and a half to three whorls, with a wide, rather shallow umbilicus, having apparently a large central vacuity. The section is subquadrangular and hexagonal; the periphery broad, compressed, very slightly convex; the sides flat, the umbilical declivities not very steep; their junction with the sides not well defined, but in the adolescent stage an obtuse angle is here formed, which becomes rounded off towards the aperture.

The whorls increase rather slowly in diameter; the last one near the aperture detaches itself for a very short distance from the penultimate whorl. The peripheral area only is concealed by the embracing whorls, the sides of the inner whorls being entirely exposed.

The body-chamber appears to extend to about half a volution; the outline of the aperture has not been seen.

The septa are numerous; there are about twenty-two in a complele volution in the young shell. They curve abruptly backwards upon the sides and periphery, forming an acute angle upon the edge of the latter. The last two septa are 5 mm. apart.

The siphuncle has not been seen.

The ornamentation consists of numerous acute, longitudinal ridges, of which there are nine or ten comparatively coarse ones upon the sides and umbilical declivities, and eleven finer ones upon the peripheral area. The ridges are finer and less prominent at the lower part of the umbilical declivity, near the suture of the shell, and become gradually stronger and more distinctly defined, as well as wider apart, until the edge of the periphery is reached, upon the surface of which they are very delicate, though preserving their distinctness.

The finer ornaments consist of a series of very fine transverse lines, which, thickening as they cross the ridges, give to the latter a strikingly crenulated character.

These lines cross the whorls with a slight backward deviation, but on the peripheral area they describe a very deep, backwardly-directed sinus, which indicates a hyponomic sinus at the aperture of similar form.

Dimensions.

	Specimen from Glenbane, Limerick.
Diameter of shell	64 mm.
„ umbilicus (from edge to edge)	40 „
„ „ (from suture to suture)	30 „
Height of outer whorl (dorso-ventral)	16 „
Width of periphery of outer whorl	20 „

Affinities.—This species may be compared with *T. Hyatti*, but the resemblance between them is of a very general character, the differences that distinguish them being, on the other hand, very strongly marked. Looking first at the points of agreement, we find that, like *T. Hyatti, T. Hibernicum* is ornamented with longitudinal ridges which cover the whole of the shell, and that the general form of the latter is distinctly subquadrangular, with a flattened peripheral area and a somewhat obscurely defined separation between the sides and the umbilical declivities. The differences consist, firstly, in the presence of distinct crenulations formed at the intersection of the two systems of lines which ornament the shell in *T. Hibernicum* which are not present in *T. Hyatti;* secondly, the ornamentation is coarser in the former than in the latter, and it would seem, though my material does not admit of certainty on this point, that the central vacuity is larger in *T. Hibernicum* than in *T. Hyatti.*

Remarks.—Hyatt referred this species rather doubtfully to his genus *Rineceras*, but though the ornamentation may suggest affinities with the members of that genus, of which *R. propinquum*, de Koninck, is taken as the type, yet the form of the whorls and the close coiling indicate connection with another series of forms, and, after much deliberation, I have decided to include it in that of *Thrincoceras.*

Locality.—Glenbane, county of Limerick; near Dublin.[1]

Genus DISCITOCERAS, *Hyatt*, 1883 (emend. 1893).

DISCITOCERAS LEVEILLEANUM, *L. G. de Koninck*, sp. Plate XXVII, figs. 1—3.

1844. NAUTILUS LEVEILLEANUS, *L. G. de Koninck.* Descrip. Anim. Foss. Terr. Carb. Belgique, p. 552, pl. xlix, fig. 1 (pl. xxv, fig. 1 excl.).

1878. — — *L. G. de Koninck.* Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, Paléont., tom. ii), pt. 1, p. 143, pl. xxviii, fig. 6.

1891. DISCITES LEVEILLEANUS, *A. H. Foord.* Cat. Foss. Ceph. British Museum, pt. 2, p. 88.

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[1] British Museum specimen, "Catalogue," loc. cit.

1893. **Discitoceras Leveilleanum**, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 435.

Description.—Shell discoid, somewhat compressed, rather slowly tapering, composed of about three and a half whorls having rounded angles, and all exposed in a wide and shallow umbilicus with a central vacuity of moderate size. The section of the whorls is of a modified hexagonal form, the angles of the whorls in the adult stage showing a tendency to become rounded, so that the distinction between the umbilical, lateral, and peripheral areas almost disappears. The apex is bluntly conical, and is covered to its extreme tip by the ornamentation of the test. In the young shell the whorls are more generally rounded than at a later stage—the adolescent—when they become angular at the umbilical margin, this angularity gradually becoming softened until it finally disappears in the region of the aperture. The latter has an open sigmoid curvature, with a moderately deep hyponomic sinus upon the periphery, where also the lines of growth become coarse and irregular.

The length of the body-chamber extends to about half a volution. The shell becomes detached from the penultimate volution in approaching the aperture (Pl. XXVII, figs. 1 *a*, 2 *a*).

The ornaments of the test are strikingly beautiful. They consist of a series of fine, acute, longitudinal ridges, which, very close-set in the young shell, gradually widen out as the whorls increase in diameter, ceasing abruptly at the end of about two and a half volutions. These ridges cover the sides of the shell, the peripheral area, and the umbilical declivity, extending sometimes along the latter in three or four widely separated ridges, considerably beyond the place where the lateral ones have become obsolete.

Fine, very close-set, and remarkably regular transverse lines of growth cover the whole surface of the test, giving rise to crenulations where they cross the longitudinal ridges. These lines of growth, becoming coarser in the more mature shell, are seen to be of the nature of narrow bands; when magnified, they vary greatly in width, sometimes two, sometimes even four, occupying the space of a millimetre. Their general texture, however (if the expression may be used), suggests uniformity to the eye when unaided by the lens. They are admirably shown in the larger figure of this species (Pl. XXVII, fig. 2 *a*).

Dimensions.	Large specimen from Clane, Museum of Science and Art, Dublin.
Diameter of shell	124 mm.
Height of outer whorl	45 ,,
Diameter of umbilicus (approximate)	70 ,,

Affinities.—*Discitoceras discors*, F. M'Coy (a doubtful species), bears a close resemblance to the present species, the ornamentation being exactly similar, the difference between them consisting solely in the form of the whorls, which are more or less rounded in *D. Leveilleanum*, subquadrate in *D. discors*.

On comparing the present species with *D. Wrightii*, it is seen that the latter has fewer whorls and a much smaller central vacuity, also that the ornamentation is finer and of a different character, the finely beaded ridges in *D. Wrightii* presenting a very different aspect from the ornament of *D. Leveilleanum*.

Localities.—Clane and Naas, county of Kildare.

? Discitoceras discors, *F. M'Coy*, sp. Plate XXVII, figs. 4*a*—*e*.

1844. Nautilus (Discites) discors, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 17, pl. iii, fig. 5.
1860. — discors, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 56.
1878. — — *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. ii), pt. 1, p. 143, pl. xxx, figs. 8 *a*, *b*.
1883. Discitoceras discors, *A. Hyatt*. "Genera of Fossil Cephalopods," Proc. Boston Soc. Nat. Hist., vol. xxii, p. 292.
1891. Discites discors, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 90.
1893. — — *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 435.

Description.—Shell discoid, compressed, consisting of about three, or at the utmost three and a half volutions (not five, as stated by M'Coy), the sides of which are exposed in a large and shallow umbilicus with a central vacuity of moderate size. The section of the shell, in which lies its chief characteristic, is subquadrate, the periphery slightly convex, nearly as broad as the sides, which are flattened and distinctly angular at their edges, not rounded as in *Discitoceras Leveilleanum*.

The size of the body-chamber is stated by de Koninck (loc. cit.) to be about one-half of that of the last whorl. I have not seen it entire in any specimen.

The siphuncle is said by de Koninck to be situated in the upper third of the septa.

The septa are moderately distant, varying from 6·5 to 8 mm. apart, at about one-fourth of a whorl from the body-chamber, the last two being 5 mm. apart; their sutures are sharply bent back at the sides and form an acute lobe, anteriorly directed, upon the peripheral angles; upon the periphery they form a shallow sinus.

The ornamentation in this species is precisely similar to that of *Discitoceras Leveilleanum*, de Kon.

Affinities.—This species closely resembles *Discitoceras Leveilleanum*, de Kon., differing from it only in the form of the whorls, more or less rounded in de Koninck's species, subquadrate in M'Coy's.

Remarks.—I have much hesitation in regarding this species as valid. All the specimens I have seen (all from the Cork district—Cork or Blackrock, both in the county of Cork) are *compressed* in the dorso-ventral direction of the whorls, and rendered elliptical thereby, and all but one *distorted*. M'Coy's type has been lost; there is no specimen in the "Griffith Collection" (Dublin Museum of Science and Art), which ought to contain it, answering to his figure (loc. cit.), which shows an ornamentation, as I have said above, precisely similar to that of *Discitoceras Leveilleanum*. The specimen in the Griffith Collection is mainly a cast showing the septa, with fragments of the test, so badly preserved as to exhibit not the faintest trace of ornamentation.

When in Brussels in 1893 I made a careful study and a drawing of the specimen figured by de Koninck (' Calc. Carb.,' loc. cit.), and contained in the Museum of Natural History (Parc Léopold). His specimen is distorted in a similar manner to the Irish ones, thus strengthening the view to which I am now strongly inclined, that *D. discors* represents merely distorted or compressed individuals of *D. Leveilleanum*. If this be actually the case, the latter species would become the type of the genus, displacing the former which I proposed as the type when describing the species contained in the British Museum (' Cat. Foss. Ceph.,' 1891, pt. 2, p. 87).

M'Coy was evidently not acquainted with de Koninck's species *D. Leveilleanum*, for he could not have overlooked its obvious similarity to *D. discors*, the latter name suggesting the most salient feature in the ornamentation of de Koninck's species, viz. the discontinuance of the ridges in the adult volutions specially pointed out by M'Coy.

Localities.—Clane, and Naas (British Museum specimen), county of Kildare; Blackrock, county of Cork.

DISCITOCERAS WRIGHTII, sp. nov. Plate XXVI, figs. 3 *a*—*d*.

Description.—Shell discoid, rather compressed, with a somewhat planorbiform configuration. Whorls about three in number, rather slowly increasing in diameter, all being exposed in a shallow umbilicus with a small central vacuity.

The whorls are somewhat flattened at the sides, the periphery gently rounded. (Lateral pressure has altered the shape of the periphery in the specimens before me, making the margin subangular on one side.) The umbilical declivities being rounded, there is no well-defined boundary between them and the sides into which they merge. The whorls come into contact only upon the peripheral area, and there is consequently no overlapping.

The length of the body-chamber cannot be given with exactness, but it appears to have occupied at least half a volution. The aperture has not been seen. The last whorl detaches itself from the penultimate one in approaching the aperture.

The septa, seen only on the sides of the shell (and there exposed by artificial means), are 5 mm. apart where the diameter of the whorl is 11 mm.; thus they are, relatively to this, wide apart. The interior of the chambers is filled with clear crystalline calcite, the deposit of which has nearly everywhere destroyed the septa in the specimens before me.

The siphuncle is considerably above the centre (Pl. XXVI, fig. 3 *c*).

The ornamentation consists of extremely fine longitudinal ridges, which, as in other members of this genus, become obsolete upon the second volution. Crossing the ridges is a series of equally fine transverse lines of growth, which at the point of intersection of the two systems of lines form little nodes, which impart a finely beaded appearance to the ornamentation viewed as a whole. The ornamentation is so fine as to require magnifying to bring it out clearly. Beyond its limits irregular lines of growth are developed, which in the adult shell are here and there rather strongly marked. Otherwise the shell may be regarded as quite smooth except in the first whorl and part of the second.

Dimensions.—Diameter of shell 90 mm.; width of umbilicus 47 mm.; height of outer whorl 25 mm. (Pl. XXVI, fig. 3 *b*).

Affinities.—From *Discitoceras Leveilleanum*, de Kon., the present species is easily distinguished by the absence of the numerous and regular transverse lines invariably met with in the former, as well as by the much less prominent character of the longitudinal ridges, which, as stated above, present the finely beaded appearance, which is not the case in *D. Leveilleanum*, in which the longitudinal ornaments, as far as they are developed, are much more conspicuous than the transverse ones. *D. Wrightii* would, in fact, at first sight be taken for a perfectly smooth shell, and it is not until the lens is brought into requisition that the fine ornaments of the inner whorls are revealed.

Remarks.—This species is quite common at Little Island, near Cork, but it is rarely obtained undistorted, having generally an elliptical form with the peripheral area pressed out of shape, making one side of the shell flatter than the other. An uncompressed specimen is, however, shown in Pl. XXVI, fig. 3 *a*. I have named this species after my friend Mr. Joseph Wright, F.G.S., of Belfast.

Localities.—Little Island and Midleton, near Cork.

DISCITOCERAS COSTELLATUM, *F. M'Coy*, sp. Plate XXVIII, figs. 4 *a*, *b*.

1844. NAUTILUS (DISCITES) COSTELLATUS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 17, pl. ii, fig. 4 (three figures).
1883. DISCITOCERAS COSTELLATUM, *A. Hyatt*. Genera of Fossil Cephalopods, in Proceed. Boston Soc. Nat. Hist., vol. xxii, p. 292.
1891. DISCITES COSTELLATUS, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 87.
1893. DISCITOCERAS COSTELLATUM, *A. Hyatt*. Carboniferous Cephalopods. Second Paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 435.

Description.—Shell (fragment) discoid, consisting of portions of two of the inner whorls which are only in contact at the periphery; the section is broader than high, about in the ratio of 9 : 14. The umbilicus is deep and of moderate width. The periphery is broadly rounded, the sides are bluntly angular, sloping abruptly from the margin of the umbilicus to the point of contact of the preceding whorl. The dorsal or anteperipheral area has a slight curvature corresponding with the periphery of the whorl which it enfolds. The septa, as seen in a natural section, are rather deeply concave; their distance apart is not known. The siphuncle is central, or perhaps slightly above the centre in the young shell. The body-chamber is not known.

The ornamentation consists of about twenty-one fine longitudinal ridges, those on the sides of the shell being both coarser and wider apart than those on the periphery. The latter has a central ridge with three on either side of it closer together than the width separating them from the central ridge; a slightly greater space again occurring between the outer one of the three and the one of the coarser series which, to the number of four, occupy the area extending to the edge of the umbilicus. Within the latter only three can be seen in the specimen before me.

Extremely fine, close-set lines of growth, barely visible to the naked eye, cover the surface of the test, and show by their outline upon the periphery that the aperture possessed a very deeply excavated hyponomic sinus.

Affinities.—The character of its ornamentation would make this species easily recognisable, and it also distinguishes it from other species of *Discitoceras*, of which *D. Wrightii* is the nearest to it. The beaded ornamentation of the latter, however, differentiates it readily from *D. costellatum*.

Remarks.—The fragment now representing the present species in the "Griffith

Collection" may or may not be a portion of the specimen figured by M'Coy; if it be so it has lost more than half of its original bulk.

Locality.—Millicent, Clane, county of Kildare.

Genus—Phacoceras, *Hyatt*, 1883.

Phacoceras oxystomum, *Phillips*, sp. Plate XXVIII, figs. 3 *a*, *b*.

1836. Nautilus oxystomus, *J. Phillips*. Geology of Yorkshire, pt. 2, p. 233, pl. xxii, figs. 35, 36. (Not of Trautschold, Nouv. Mém. Soc. Imp. Nat. Moscou, tom. xiii, p. 304, pl. xxx, fig. 7.)
1843. — — *L. G. de Koninck*. Descrip. Anim. Foss. Terr. Carb. Belgique, p. 544, pl. xlix, figs. 3 *a*, *b*.
1844. — (Discites) oxystomus, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 18.
1855. — oxystomus, *F. M'Coy*. British Palæozoic Foss., fasc. iii, p. 560.
1860. Discites oxystomus, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 83.
1878. Nautilus oxystomus, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, tom. ii), pt. 1, p. 123, pl. xvii, figs. 3 *a*, *b*.
1883. Phacoceras oxystomum, *A. Hyatt*. Genera of Fossil Cephalopods, Proceed. Boston Soc. Nat. Hist., vol. xxii, 1882–3, p. 293.
1891. Discites (Phacoceras) oxystomus, *A. H. Foord*. Cat. Foss. Ceph. Brit. Mus., pt. 2, p. 99, fig. 12 (about two-thirds nat. size).
1893. Phacoceras oxystomum, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, pp. 438, 446.

Description.—" Lenticular, very much compressed laterally; greatest thickness at the edge of the small shallow umbilicus, from whence the sides slope, almost flatly, to the thin, very acutely carinated periphery; whorls about four, their edges distinctly visible in the umbilicus; the mouth very elongate, lanceolate, embracing three-fourths of the sides of the penultimate whorl. Surface of inner whorl spirally sulcated,[1] of the outer turns smooth, or with extremely fine, obsolete transverse lines of growth, having a very strong forward wave in the middle, and a small, slightly marked one at the sloping edge of the umbilicus.

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[1] This ornamentation would be more correctly described as consisting of longitudinal (or spiral) ridges, since it is raised above the surface of the test; M'Coy's term implies a grooved or incised surface.

Internal casts show the septa strongly arching forwards from the umbilicus to a flat, solid band, about two or three lines wide, produced by the internal cavity not quite reaching the edge; the last chamber [body-chamber] occupies rather less than half the last whorl, and is marked by a narrow, deep sulcus, a little on the inner side of the middle, produced apparently by a corresponding ridge on the interior of the shell (Pl. XXVIII, fig. 3 *a*),[1] of which there is no trace on the outside. . . . I have not been able to observe the siphuncle in this species, but according to de Koninck it is very small and nearly central, a little outside of the middle. The inner whorl is scarcely embraced by the succeeding one, is not compressed, and has a broad, convex periphery; the next has a much more acute periphery, and is correspondingly embraced by the succeeding turn." (M'Coy, 'British Palæozoic Fossils,' fasc. iii, 1855, p. 560.)

I am indebted to the kindness of my friend Mr. G. C. Crick, of the British Museum, for the measurements given below, and he has also indicated to me by means of a diagram the exact position of the siphuncle, which he ascertained by temporarily separating the two halves of the specimen which had been united by an adhesive. It proves to be nearer the centre of the septum than de Koninck represents it to be,—that is, the height of the septum (the one measured was the last) being 35·5 mm., the siphuncle occurs at a distance of 20 mm. from the dorsal or wider extremity, and consequently 15·5 mm. from the peripheral or narrower extremity of it.

Dimensions.

		Specimen in "Gilbertson Coll.," British Museum.
Diameter of shell (without the test) . . .		85 mm.
,, umbilicus (with the test) . .		23 ,,
Greatest thickness of shell (without the test) measured at the anterior end of the body-chamber, below the curved line		15 ,,
The same at the last septum . . .		13·5 ,,
Depth of last four chambers (No. 1 being the last) as follows	(1)	2·25 ,,
	(2)	2·75 ,,
	(3)	3 ,,
	(4)	3 ,,

Affinities.—There is really no species which will bear comparison with the present one, which thus holds a solitary position among Palæozoic Nautiloids. De Koninck's comparison of it with the *Nautilus complanatus* of J. Sowerby ('Min. Conch.', 1821, vol. iii, p. 109, tab. cclxi) is not justified by the possession of any specific characters common to the two species. Sowerby's species, with its wide umbilicus, numerous whorls, and sutures with sharply bent sinus, can have no affinities with a shell of the structure of *P. oxystomum*.

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[1] Seen on the cast of the body-chamber as a curved line following the contour of the shell.

It has already been pointed out by de Koninck[1] that the species referred to the present one by H. Trautschold[2] has no affinities with it. This species of Trautschold, to which de Koninck has given the name *Nautilus Rouillieri* (loc. cit.), has since been figured by M. Tzwetaev (loc. cit.). The form of the sutures, which recalls that of *Hercoglossa*, is quite anomalous among the older palæozoic nautiloids. They are strongly and abruptly bent forwards along the margin of the umbilicus, and again bent, but in a wider curve and in the contrary direction, in the middle of the sides. The acute form of the periphery and the generally compressed habit of the shell are, indeed, the only features in which *N. Rouillieri*[3] resembles *P. oxystomum*. The two species are further distinguished by the fact that the umbilicus in the former is much smaller than in the latter.

Remarks.—If the figure given by de Koninck in his 'Calcaire Carbonifère,' pt. 1, pl. xvii, were correct, it would lead to the supposition that the Belgian species of *Phacoceras* was not identical with the one figured and described by Phillips under the name of *P. oxystomum*. De Koninck's figure represents a species with an umbilicus relatively much smaller than that of the last named. The figure given by de Koninck in his 'Description des Animaux Fossiles,' etc., pl. xlix, is much more accurate in this respect; both give a view of the inner whorls, the importance of which, from the classificatory point of view, has been well pointed out by Hyatt.[4] It is on the ground that the young have the form and proportions of *Discitoceras* that he gave *Phacoceras* the temporary place here assigned to it; but it is evident that further investigations will be necessary before the question of the true affinities of this singular genus can be solved. It is, however, a rare fossil.

It is unfortunate that the only specimen accessible to me for purposes of description and representation in the accompanying plate (Pl. XXVIII) is not localised. The occurrence of the species in Ireland is, however, well authenticated, Phillips and Griffith (in M'Coy's 'Synopsis') both referring to it; the former as occurring at Florence Court, near Enniskillen, the latter at Drumscraw

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[1] "Faune Calc. Carb. Belgique" ('Ann. Mus. Roy. d'Hist. Nat. Belgique,' sér. Palæont., tom. ii), pt. 1, p. 124.

[2] 'Nouv. Mém. Soc. Imp. Nat. Moscou,' 1874, tom. xiii, p. 304, pl. xxx, fig. 7. See also M. Tzwetaev, 'Mém. Com. Géol. St. Pétersbourg,' 1888 vol., No. 3, pl. vi, figs. 33, 34.

[3] Assigned by Hyatt to his genus *Stenopoceras*, "Carboniferous Cephalopods." 'Geological Survey of Texas, Fourth Annual Report,' 1892, p. 446.

[4] "Carboniferous Cephalopods." Second paper. 'Geological Survey of Texas, Fourth Annual Report,' 1892, p. 438.

(Drumquin), in the county of Tyrone. Phillips records it also from the Isle of Man, and M'Coy ('British Palæozoic Fossils,' fasc. iii, 1855, p. 560) from Lowick, in Northumberland.

PHACOCERAS ? RECTISUTURALE, sp. nov. Plate XXIX, figs. 2 *a*—*c*.

Description.—Shell (cast) somewhat compressed, discoid, with a deep umbilicus, in which the inner whorls must be partially if not wholly exposed; they are not visible in the (unique) specimen before me. The section of the whorls in the adolescent stage is pentagonal; expressed in more general terms it may be called sagittate. In the adult, owing to the rounding off of the periphery, it becomes roughly hexagonal. The periphery in the outer whorl is subacute as far as the body-chamber, towards the base of which it becomes more rounded, and forms a narrow ventral area. The body-chamber being imperfect, its size relative to the whole shell cannot be stated. The umbilicus is very deep with steep walls, the edge narrowly rounded—at least it is so in the cast. Owing to the rapid lateral expansion of the whorls the sides gain in depth with corresponding rapidity up to the body-chamber, near the base of which the greatest thickness of the shell, viz. 45 mm., is attained, from whence it quickly tapers towards the periphery (Pl. XXIX, fig. 2 *c*). So far as can be observed the overlapping of the whorls is very slight.

The septa are moderately distant from each other in the adolescent stage, their greatest width apart being here about 10 mm., but in approaching the body-chamber they become crowded together, the last two being only 3 mm. apart (Pl. XXIX, fig. 2 *a*). Their sutures are remarkably straight, especially near the body-chamber, indicating that the septa were extremely flat.

The siphuncle is not seen.

Only fragments of the test remain, and these are perfectly smooth.

Dimensions.

Diameter of shell	95 mm.
„ umbilicus	28 „
Height of outer whorl	43 „
Thickness at umbilical margin . . .	45 „

Affinities.—In the present state of uncertainty as to the affinities of this fossil, chiefly owing to the want of the inner whorls, it seems scarcely advisable to attempt to compare it with any other species. I have always regarded it, however, as related, though perhaps remotely, to *Phacoceras oxystomum*, Phill., and to this, perhaps only fancied (as time may show), relationship I have given practical expression by putting it in the same genus. I would, however, beg of those who are interested in the matter to consider this as a temporary act on my part, and one which is subject to revision should occasion require it.

The differences between the present species and *P. oxystomum* may, indeed, be taken in at a glance (cf. Pl. XXVIII, figs. 3 *a*, *b*). The stout form and remarkably straight sutures of the one are in marked contrast with the curved sutures and extremely attenuated habit of the other. The resemblance between them is reduced, in fact, so far as the outer whorl is concerned, to the common feature of an acute periphery.

Remarks.—In dealing with this new form two courses were open to me; one was to found a new genus for its reception, the other to merge it in one already known. I have chosen the latter alternative, because there is but a single individual, and its condition is such as to preclude the possibility of investigating the important characters which are afforded by the initial whorls, owing to their being partly destroyed, partly hidden by the matrix filling the umbilical depression. It must be left, therefore, to further research to supply this deficiency. Meanwhile the above description will serve to distinguish the fossil, and by its imperfect character draw attention to the fact that more information regarding it is a desideratum.

I am glad of this opportunity to express my indebtedness to Mr. G. H. Elliott, the Chief Librarian of the Free Public Library, Belfast, for kindly affording me every facility to examine and figure the specimen described above. It is contained in the collection of fossils made by the late Canon Grainger, D.D., M.R.I.A., of Belfast, who presented his large collections (ethnological, zoological, geological, etc.) to the institution just named, where they are under careful curatorship and are fully accessible to students.

Locality.—There is, unfortunately, no record, but as nearly all the fossils in the Grainger Collection came from Kildare, the chances are greatly in favour of the one here described having been obtained in that county.

[VESTINAUTILUS CARINIFERUS, *J. de C. Sowerby*, var. *triplicatus*, var. nov. Plate XXVIII, figs. 2 *a*, *b*. (See *supra*, p. 82.)

The very strong folds near the aperture (much too obscurely rendered in the figures) is so marked a feature in this individual, the only one known to me, that it demands particular notice. Only three folds are to be distinguished, the outer one of which bridges over the space extending from the edge of the umbilical keel to that of the aperture; this fold is flattened and rather inconspicuous. The middle one, which is very prominent (much more so than the drawing indicates—fig. 2 *a*), curves forward from the border of the umbilical keel, and, taking a course corresponding nearly with the curvature of the hyponomic sinus, becomes obsolete before the centre of the latter is reached. The breadth of the folds nearly equals that of the space between them. Of the inner fold but little remains, as the test is here broken away, and it seems evident that the folds originated in a thickening of the test, there being only a slight trace of them upon the cast. In other features there seems to be nothing to distinguish this shell from *V. cariniferus*, though the septation being covered by the test, its identity with that species is not quite so firmly established as could be wished. The body-chamber, where it is bare of the test, is very distinctly marked on the peripheral part by the "Runzelschicht" (Pl. XXVIII, fig. 2 *b*), which consists, as usual, of minute pits, lineally arranged, the lines conforming exactly with the contour of the aperture. The test shows fine lines of growth (seen also in fig. 2 *b*), somewhat irregularly spaced, and having naturally the same direction as those of the Runzelschicht.].

Family COLOCERATIDÆ.

Genus COLOCERAS, *Hyatt*, 1893.

COLOCERAS COYANUM, *A. d'Orbigny*, sp. Plate XXX, fig. 3.

1844. NAUTILUS (TEMNOCHEILUS) PINGUIS, *F. M'Coy*. Synop. Carb. Foss. Ireland, p. 22, pl. iv, fig. 12 (*not* of L. G. de Koninck).
1847. — HIBERNICUS, *A. d'Orbigny*. Paléont. univers., tom. i, pl. ci, figs. 2, 3.
1850. — COYANUS, *A. d'Orbigny*. Paléont. stratigr., tom. i, p. 111.
1860. TEMNOCHEILUS PINGUIS, *R. Griffith*. Journ. Geol. Soc. Dublin, vol. ix, p. 56.
1878. NAUTILUS COYANUS, *L. G. de Koninck*. Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Palæont., tom. ii), pt. i, p. 101, pl. xxxi, figs. 2, 3.
1893. COLOCERAS COYANUM, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 452.

Description.—Shell thick-discoid, subglobose, subhexagonal in transverse section until the body-chamber is reached, when the angularity of the sides becomes obsolete; the inner whorls exposed in a deep funnel-shaped umbilicus, partly filled with matrix in the unique specimen now under description. The umbilicus is bordered up to the base of the body-chamber by a sharp keel, which completely disappears upon the body-chamber. The whorls overlap to the edge of the keel, which is thus concealed until the last whorl releases itself from its contact with the penultimate one. The periphery is rather broadly rounded, and presents longitudinally three rather ill-defined zones. The aperture has a deep hyponomic sinus. The body-chamber occupies about one-half of the last whorl. The test is smooth. Neither septa nor siphuncle are seen in the specimen before me.

Dimensions.

	Sci. and Art Mus., Dublin. M'Coy's type, "Griffith Coll."
Diameter of shell	52 mm.
„ umbilicus (from edge to edge)	30 „
„ „ (from suture to suture)	19 „
Height of outer whorl (dorso-ventral)	21 „
Thickness at umbilical margin	28 „

Affinities.—There is ample justification for Hyatt's observation (loc. cit., p. 449) as to the resemblance of the shells included in the group *Coloceras* to those of *Vestinautilus*. At first sight there seems little of consequence to separate M'Coy's type from a young specimen of *V. cariniferus*, but a closer comparison shows that the latter has more numerous whorls and a proportionally wider umbilicus than the former, as already remarked by M'Coy. According to Hyatt also the developmental history of the two groups (*Coloceras* and *Vestinautilus*) is distinct. Comparing the present species with *C. bistrialis* (described below), Hyatt says that the former is a more slender and less involute shell than the latter, and the longitudinal ridges are not so persistent. He adds that "there are two good specimens [of *C. Coyanum*] in the Museum of Comparative Zoology (Cambridge, Mass.), which show that this and *C. globatus*, de Kon., as figured in the 'Calc. Carb.' (loc. cit.) [Pl. XXXI, figs. 1 *a*, *b* (not 1 *c*—*e*)], are probably identical." This may be so, but it must be understood that the *C. globatus* of de Koninck is not that of J. de C. Sowerby.

Remarks.—The figure of the type specimen (the only one extant) is reversed in the 'Synopsis;' it is represented in its natural aspect in the figure I have given of it (Pl. XXX, fig. 3). If this figure be compared with those on Pl. XXIII, numbered 1 and 2, it will be seen how close is the general resemblance of *Coloceras Coyanum* to *Vestinautilus cariniferus*.

Localities.—Kilmallock, near Limerick (M'Coy's type); Ballyduff, near Dungarvan, county of Waterford (*fide* Sir R. Griffith).

Coloceras bistriale, *J. Phillips*, sp. Plate XXX, figs. 2 *a—c*.

1836. **Nautilus bistrialis**, *J. Phillips*. Geology of Yorkshire, pt. 2, p. 232, pl. xvii, fig. 21.
1844. — (**Temnocheilus**) **bistrialis**, *F. M'Coy*. Synop. Carb. Foss Ireland, p. 20.
1891. **Cœlonautilus bistrialis**, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 130.
1893. **Coloceras bistriale**, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 451.

Description.—Shell small, globose, composed of about two and a half whorls, all exposed in a deep umbilicus. The apex is not seen, but it would appear that the form of the young shell, so far as can be made out, does not materially differ from that of the adult. The section of the whorls is roughly hexagonal, the periphery broadly rounded with a shallow median depression; from this the shell slopes on each side to the edge of the umbilicus. The latter has a sharp keel, which does not reach beyond the beginning of the body-chamber, whence the shell is obtusely rounded up to the aperture. This has a deep hyponomic sinus (very distinctly outlined on the body-chamber, Pl. XXX, fig. 2 *c*), with its edge sharply reflected (fig. 2 *a*). Two fine but distinct ridges encircle the inner whorls just within the umbilical keel, this ornamentation having suggested the specific name. The test is quite smooth. Distinct traces of the Runzelschicht are seen upon the cast of the body-chamber in one of the specimens before me.[1]

Neither septa nor siphuncle are known.

Dimensions.

	Specimen figured Pl. XXX, fig. 2.
Diameter of shell	50 mm.
,, umbilicus (from edge to edge) .	33 ,,
,, ,, (from suture to suture) .	22 ,,
Height of outer whorl (without the test) . .	18 ,,
Breadth ,, ,, ,, . .	27 ,,

Affinities.—*Nautilus globatus*, de Koninck[2] (not J. de C. Sowerby), resembles the present species in having a series of ridges encircling the umbilical walls, but the shell expands much more rapidly than Phillips's, and cannot be considered identical with it.

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[1] A nearly perfect specimen (figured loc. cit.) contained in the Museum of Science and Art, Dublin (Geological Survey Collection).

[2] Faune Calc. Carb. Belgique (Ann. Mus. Roy. d'Hist. Nat. Belgique, sér. Paléont., tom. ii), pt. i, p. 95, pl. x, figs. 4 *a*, *b* (excl. figs. 2, 3).

I am not able to agree with de Koninck in regarding the present species as identical with J. de C. Sowerby's species *Nautilus globatus* (= *Planetoceras globatum*, Hyatt, *supra*, p. 96). The distinctive character of that species is the laterally spreading form of the last whorl, with its excessively wide, dorso-ventrally contracted aperture. This expansion of the whorl is always seen commencing in the young shell, and this in individuals quite as small as the one figured in the plate accompanying this description (Pl. XXX, fig. 2 *a*). Besides this, *P. globatum* has no keels or ridges on the umbilical walls; it has only the keel on the edge of the umbilicus, very strongly developed in the adult shell. Another feature, absent in *Coloceras bistriale*, is very marked in *P. globatum*, and that is the last whorl being produced beyond the coiled part of the shell, so that the aperture never touches the penultimate whorl.

C. bistriale is easily distinguished from *C. Coyanum* by its relatively much larger umbilicus, and by the ridges that encircle the umbilical walls.

Localities.—Clane, county of Kildare; Tomdeeley, county of Limerick.

Family SOLENOCHEILIDÆ.

Genus AIPOCERAS, *Hyatt*, 1883.

AIPOCERAS COMPRESSUM, *A. H. Foord*. Plate XXX, figs. 1 *a*, *b*.

1891. GYROCERAS (AIPOCERAS) COMPRESSUM, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 68, figs. 6 *a*, *b*.

1893. AIPOCERAS COMPRESSUM, *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 454.

Description.—Shell compressed, composed of about two volutions which are not in contact; these increase in diameter with moderate rapidity. The section is roughly trigonal or cuneiform. The initial point is somewhat obtuse; it bears no trace of a cicatrix. The dorsal area, which is completely exposed, is proportionally broad and flattened, and slightly raised along the median line, falling away on either side of this to the subangular umbilical margin. The sides are also flattened, and their junction with the narrowly rounded periphery is undefined.

The body-chamber is very large, occupying about two-thirds of a volution. There is a slight emargination on the superior border of the aperture, representing the hyponomic sinus.

The septa are moderately distant from each other, indicating shallow chambers. The sutures are very slightly curved backwards upon the sides of the shell, bending a little forwards on the peripheral margin, and crossing the periphery with a very slight backward curvature.

The sutures exposed to view give the following depth for the chambers, reckoned from the body-chamber posteriorly, measurements being taken at about the middle of the lateral area :

1	11·0 mm.
2	16·0 „
3	15·5 „
4	14·0 „
5	12·5 „
6	11·0 „
7	9·5 „
8	8·0 „

The siphuncle is ventral.

The test is perfectly smooth.

Dimensions.

	Large specimen from Clane in Science and Art Museum, Dublin.
Diameter of shell	170 mm.
„ umbilicus	50 „
Height of whorl on body-chamber at about 65 mm. from its base	84 „
Thickness at edge of umbilicus near base of body-chamber	55 „

Affinities.—The distinctly wedge-shaped whorl and the compressed form of the shell in this species distinguish it completely from *Aipoceras gibberosum*, de Koninck, sp., the only one with which it can be compared.

Remarks.—These evolute forms of the Solenocheilidæ are singularly interesting, because they supply one of the links in the chain that connects the straight shells of the Carboniferous seas and those which are curved, or partially curved, with the completely involute ones. Their relationship with *Asymptoceras* and *Solenocheilus*, so far as the form of the shell can dictate it, seems to be clearly made out. The triangular section of the whorl, the ventral position of the siphuncle, and the nature of the septa are similar, except in minor particulars, to those of the genera named. It is only in the matter of uncoiling that they stand alone among the Solenocheilidæ.

The same connection between simply curved and evolute shells and involute ones may be traced in the genus *Trigonoceras* (through its two species, *T. paradoxicum* and *T. aigoceras;* the one coiled only in the earlier stages of the young shell, the other evolute), and the more or less closely coiled (involute) shells represented in the genera *Cœlonautilus, Apheleceras*, and others of their tribe.

Locality.—Clane, county of Kildare.[1]

Genus ACANTHONAUTILUS, *Foord*, 1896.

ACANTHONAUTILUS BISPINOSUS, *A. H. Foord.* Plate XXVIII, fig. 1; Plate XXIX, fig. 1.

1896. ACANTHONAUTILUS BISPINOSUS, *A. H. Foord.* Ueber die Orthoceren des Kohlenkalks (Carboniferous Limestone) von Irland. . . Inaugural-Dissertation zur Erlangung der Doktorwürde . . . der Kgl. bayer. Ludwig-Maximilians-Universität zu München, p. 42.

1897. — — *A. H. Foord.* Geological Magazine, New Series, decade 4, vol. ix, p. 147, pl. vi; also J. F. Blake, ibid., p. 287.

1900. — [BISPINOSUS], *A. Hyatt.* In the translation of Karl A. von Zittel's Text-book [Grundzüge] of Palæontology, edited by Charles R. Eastman,[2] p. 525.

Description.—Shell of medium size, nautilus-like in its general habit, somewhat globose, and expanding rapidly; consisting of about two or two and a half volutions, the inner ones concealed by the lateral expansion of the shell. The peripheral area is broadly rounded and somewhat flattened on the body-chamber, especially towards the aperture in the adult, but more narrowly and evenly rounded in the younger stages of growth. The umbilicus is rather large and very distinctly funnel-shaped. It is provided with a thick and very conspicuous rim, which is produced into long, flat, hollow, spine-like processes, projecting almost at right angles to the longitudinal axis of the shell on each side of it. The spines, whose flatness is nearly on the same plane as the adjacent part of the surface of the peripheral area, are greatly expanded at the base, but become rapidly narrow towards their distal end, their basal portion merging with a slight concavity in the general surface of the ventral part of the shell on the outer side, while on the inner side they are continuous with the umbilical margin. The spines are met anteriorly by the border of the aperture, posteriorly by the rim of the umbilicus, from which they proceed on that side. They thus make here a curve on their inner edge, which is directed outwards and slightly downwards at the same time. The direction of the spines in relation to the longitudinal axis of the shell is nearly that of a right angle, with a slight curvature of the flattened aspect inclining away from the periphery and towards the umbilicus.

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[1] A small, remarkably well-preserved specimen of this species is contained in the British Museum.

[2] With the exception of a few introductory pages, the whole of the class Cephalopoda in this work has been revised and in great part rewritten by Professor Hyatt, who has introduced a new classification for the larger groups, and many new genera. He has also added a very copious and useful bibliography.

Both of the spines are imperfect, one having been broken off near the base, the other wanting a portion of the extremity. The former is seen to begin with two diverging folds of the shell, originating as above described. These make an angle, as seen in the section of the broken stump, the blunt apex of the angle being formed by the rim, already described as an extension of that of the umbilicus. The two folds rapidly approach each other, till, as the more perfect spine shows, they run nearly parallel, forming a flattened tube up to the end of the spine, as far as it is preserved. The flattening here referred to may be partly due to pressure in the rock; but, on the other hand, the pinched appearance of the two folds of the shell near the base of the spine, where there is no evidence whatever of crushing, is already so marked as to contradict the supposition of flattening by any such accidental agency.

The outline of the aperture, which can be distinctly traced, is curved gently forward on either side, and forms in the centre a broad and shallow hyponomic sinus.

The sutures, of which only five are visible, are moderately distant, the last two somewhat closer together than the rest. The septa have been completely destroyed by the deposition of crystalline calcite in the chambers, the removal of a great part of this calcite disclosing no traces of them; nor were any remains of the siphuncle met with.

The distances between the septa which are exposed to view, measured from the posterior to the anterior one, are 14 mm., 17 mm., 13 mm., and 12 mm., the last one measured being probably next to the body-chamber.

The test is quite smooth, only slightly marked lines of growth occurring on the body-chamber.

Dimensions.

	Specimen in Museum of Science and Art, Dublin.[1]
Diameter of shell	160 mm.
„ umbilicus . . .	25 „
Height of outer whorl (dorso-ventral) . .	80 „
Thickness at umbilical margin . . .	100 „
Width of shell (ventrally) just above the origin of the spines	120 „
Width of periphery at aperture of shell . .	90 „

Affinities.—I have drawn attention elsewhere[2] to the resemblance between the present species and the one described under the name of *Nautilus cornutus* by Golowkinsky,[3] from the Permian formation of the central part of the basins of the rivers Kama and Volga. I am now enabled, through the kindness of a friend, to give a translation of the original description from the Russian of that author, by which the two species may be more satisfactorily compared. It runs as follows:—"It [*N. cornutus*] has three or four whorls, which grow quickly in breadth, forming a deep umbilicus; each whorl covers about half of the preceding one, and has, when cut transversely, the form of a crescent with rounded ends. The periphery is flattened in large specimens. The sutures form a slightly waved line, which curves backwards on the umbilical whorl and on the sides of the shell, and more slightly so upon the periphery. The siphuncle lies nearer to the umbilicus than to the periphery, and is therefore a little below the centre of the septa. The body-chamber occupies approximately one-third of the last whorl, and presents at the aperture a roundish contour, with a sharp angle on each side where the lateral margin unites with the umbilical wall. Here, taking a course almost at right angles to the periphery, a tubular process [spine] is formed, which juts out from each side of the aperture like a horn.

"Thus the horn-like spines are formed by a fold in the test, which unites along a line extending outwards from the lower angle of the apertural margin. The extremity of the spines is open. Their general direction is nearly at right angles to the longitudinal axis of the shell; but they have a strong upward inclination, and are also slightly curved. In the large specimen [figured], measuring 100 mm. in diameter, the length of the spines is 55 mm. The periphery at the aperture projects a little in front of the spines. The surface of the shell is covered with fine lines, which, upon the periphery, form a backwardly directed, very small angular sinus, through the centre of which there runs longitudinally a slight keel or raised line. The sinus forms a little notch in the margin of the aperture.

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[1] A cast has been deposited in the British Museum.

[2] 'Geological Magazine,' New Series, decade 4, vol. iv, p. 287.

[3] 'Matériaux pour la Paléontologie Russe,' tom. i, 1869, p. 381, tab. v, figs. 15—19.

"The greatest diameter of the shell is 100 mm., the greatest width 80 mm., the greatest height 45 mm.; length of spines, 55 mm.

"The extension of the last chamber into horn-like processes reminds one of *Nautilus Seebachianus*, Geinitz (Dyas, Bd. i, S. 43, Taf. ix, fig. 7), which has a leaf-like expansion of the body-chamber extending longitudinally and laterally. The likeness of form is shown by the raised line or keel which passes along the centre of the periphery, and is absent in *Nautilus Freieslebeni*.

"R. Ludowick, who has seen a specimen of this species in the Geological Museum of the Kazan University, calls it *Nautilus Freieslebeni* (Dyas, Bd. ii, S. 295), and indicates Nijini Tyvesniak, in the vicinity of Kazan, as the place where it is found. This is not correct, as I found it myself, in the year 1859, in the Verchni Tyvesniak, at the mouth of the Tanassalka. It is very often found in the Verchni Tyvesniak, on the Volga, at a little distance between Bourtas and Antonovka, especially near the village of Krasnovidof."

From this description it may be gathered that the two species differ in the following particulars:—In *Acanthonautilus bispinosus* the shell has fewer whorls, and the spines have not the upward curvature which is such a marked feature in the Russian species. Further, the septa are much less numerous in the former species than they are in the latter. There is also a very broad though shallow hyponomic sinus in the aperture of *A. bispinosus*, while in *A. cornutus* this structure is scarcely more than a notch. Lastly, the umbilical border in *A. cornutus* is distinctly angular, with steep sides; in *A. bispinosus*, on the other hand, it has a rounded rim. Hence there seems to be amply sufficient ground for separating the two species, whose resemblance is restricted to the spines which each possesses.

Remarks.—It would seem from Golowkinsky's description that *Acanthonautilus cornutus* was not an uncommon species—at least in the district where it was found.

From a list of the fossils of the region given by Golowkinsky in his memoir, it appears that they are typical of the lower Zechstein division of the Dyas of Germany. Hence the horizon of *Acanthonautilus* has been extended vertically by the discovery of the Irish species, which can thus boast of a somewhat greater antiquity than its Russian congener.

That *A. cornutus* should have been completely overlooked by palæontologists till within the last few years is, perhaps, not very remarkable, the description being contained in a journal, apparently not well known out of Russia, printed in Russian, and containing no abstract in German or French by which its valuable contents would be made known to the student unacquainted with that language.

This serious drawback is partly redeemed by the excellent lithographic illustrations of the fossils described in the text.[1]

The generic affinities of *Acanthonautilus* are clearly those which are indicated in Professor Hyatt's association of it in the family Solenocheilidæ;[2] and if the spines had been absent the two species representing the genus would have fallen naturally into the genus *Asymptoceras*.

Locality.—Clane, county of Kildare.

Genus ASYMPTOCERAS, *Ryckholt*, 1852 (emend. *Hyatt*, 1883, 1893).

ASYMPTOCERAS CRASSILABRUM, sp. nov. Plate XXXI, figs. 1, 2.

Description.—Shell nautilus-like in general form and aspect, the whorls increasing rapidly, subquadrate in section from an early stage of growth, and more distinctly so in the adult; the sides broad and flattened, the periphery slightly depressed along the median line, its breadth considerably less than that of the shell at the umbilical margin owing to the upward convergence of the sides. Umbilicus deepening rapidly as the shell expands, the initial whorl leaving an oval vacuity. The aperture has apparently a shallow hyponomic sinus on the periphery, and in front the lip forms a prominent rounded rim, caused by its inward folding. This rim does not extend beyond the walls of the umbilicus.

The body-chamber occupies about one-half of the last volution.

The septa are very wide apart. Where the breadth of the periphery is 20 mm. they are 13 mm. apart, where it has increased to 50 mm. in breadth they are 24 mm. apart; and the measurements of the last chamber give for the periphery and septa respectively 55 mm. and 20 mm.

The ventral siphuncle, characteristic of the Solenocheilidæ, is seen in a large specimen, from which some of the shell has been broken away, in the shape of a slender tube about 3·5 mm. in diameter, partly buried in the rock which fills the chambers. The test is apparently smooth everywhere except upon the rim which borders the front of the aperture, where there is a series of fine and regular lines running parallel with its edge.

The impression of the shell muscles is plainly indicated on one of the specimens before me. It consists of a fine incised line about 4 mm. above the basal edge of the body-chamber, running nearly parallel thereto in the umbilicus and on the sides of the shell, but becoming slightly deflected upon the periphery, where it is nearly double the distance from the basal edge of the body-chamber that it was on the sides, viz. 8 mm., making here a depressed arch. Exactly in the centre of the periphery this arch culminates in a small sinus, after which the same phenomena are repeated on the other side.

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[1] The copy of the work to which I fortunately gained access is contained in the admirably quipped library of the Geological Society of London, Burlington House.

[2] Loc. cit.

Dimensions.

	Specimen from Clane, in Science and Art Museum, Dublin, figured Pl. XXXI, fig. 2.
Diameter of shell	180 mm.
„ umbilicus (edge to edge)	68 „
„ „ (suture to suture)	40 „
Height of whorl (dorso-ventral)	110 „
Thickness at umbilical margin	105 „
Breadth of periphery near the aperture	83 „

All the above measurements are taken from the specimen indicated, except the last, which was taken from the one represented by fig. 1 on the same plate, as the periphery in this was more perfect.

Affinities.—The most nearly related species to the present one is that described below—*Asymptoceras Foordi*, Hyatt,—but the distinction between them is strongly marked. Instead of the lip-like rim in front of the aperture, which is the characteristic feature of *A. crassilabrum*, there is in *A. Foordi* a broad swelling here, causing the body-chamber to be produced beyond the penultimate whorl to a much greater extent than is the case with the former species. Besides this, *A. Foordi* is considerably contracted at the aperture, and the periphery is broadly arched instead of being flattened, and even slightly concave, as in *A. crassilabrum*

Remarks.—I drew attention on a former occasion[1] to the fact that the names *Vestinautilus* and *Asymptoceras*, as previously pointed out by de Koninck,[2] were based on errors of observation on the part of their author, Baron de Ryckholt.[3] Hyatt, however, has restored and given currency to both these names, first in his "Genera of Fossil Cephalopods,"[4] and more recently in his "Carboniferous Cephalopods."[5]

In spite of cogent reasons that might be urged against the retention of names founded upon erroneous data, the fact that de Ryckholt indicated the species to which he intended his generic names to be applied may be held partly to justify their use, though not dispensing with the necessity for defining the genus.[6] It is, indeed, quite possible that the obscure pamphlet in which ***Vestinautilus*** and ***Asymptoceras*** were introduced might have escaped notice had not de Koninck directed attention to it in his summary of the history of the family Nautilidæ (loc. cit.). Their resuscitation by Hyatt has at least the merit of sparing science the infliction of two new names which must have been found for the group of species split off by him from *Cœlonautilus* and *Solenocheilus*, to the former of which groups the name *Vestinautilus* is now applied (type, *Nautilus Koninckii*, d'Orb.), to the latter the name *Asymptoceras* (type, *N. cyclostomus*, Phill.). The types here referred to were both indicated by de Ryckholt himself in the pamphlet quoted above.

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[1] 'Cat. Foss. Ceph. British Museum,' 1891, vol. ii, p. 167.

[2] 'Faune Calc. Carb. Belg.,' 1878, pt. 1, p. 86.

[3] 'Notice sur les genres *Nautilus*, *Vestinautilus*, *Asymptoceras*, *Coya*, et *Terebrirostra*,' p. 4.

[4] 'Proc. Boston Soc. Nat. Hist.,' 1883, pp. 294, 296.

[5] 'Geol. Surv. Texas, Fourth Annual Report, 1892' (reprint, 1893), pp. 419 and 456.

[6] Loc. cit., pp. 77—88.

Locality.—Clane, county of Kildare (the only place in which this species has yet been found).

ASYMPTOCERAS FOORDI, *A. Hyatt.* Plate XXXII, figs. 1 *a*, *b*, 2, 3.

1891. SOLENOCHEILUS CONSPICUUS, *A. H. Foord.* Cat. Foss. Ceph. Brit. Mus., pt. 2, p. 175, figs. 31 *a*, *b* (*not* of L. G. de Koninck).

1893. ASYMPTOCERAS FOORDI, *A. Hyatt.* Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 459.

Description.—Shell nautilus-like, with about two rapidly increasing whorls, which contract towards the aperture. Section subquadrate. The sides broad, merging imperceptibly into the periphery, which is narrowly rounded in the young and adolescent stages of growth, but from the body-chamber to the aperture it becomes much more broadly rounded, the contraction beginning at about the last fourth of the body-chamber.

The aperture presents a wavy line, forming a broad and shallow sinus at the sides of the shell, and a deeper hyponomic sinus upon the periphery. In front it is slightly curved forward. Here there is a prominent rim or swelling extending from one umbilical margin to the other, and causing the lip of the aperture to be bent inwards. This swelling naturally makes the body-chamber project a little from the rest of the whorl. The umbilicus, the edge of which is obtusely angular, deepens rapidly after the first whorl is completed, the initial whorl leaving a small vacuity in its centre.

The zone of impression is very shallow and indistinct.

The incised impression of the shell muscles is more or less distinctly marked upon the cast of the body-chamber in three of the specimens before me. It forms a widely arched, forwardly directed curve from the umbilical margin to the centre of the periphery, repeating a similar curve on the other side. On the wall of the umbilicus the impression runs nearly parallel with the basal edge of the body-chamber.

The chambers are moderately deep. The last six (leaving the body-chamber out of account) give the following measurements,[1] No. 1 in the table representing the last chamber, No. 2 the penultimate, and so on.

[*Note.*—The measurements are taken at about the middle of the lateral area. See Pl. XXXII, fig. 1 *a*.]

1	13·0 mm.
2	15·5 „
3	14·0 „
4	13·5 „
5	10·5 „

The siphuncle traverses the margin of the periphery in the median line (Pl. XXXII, figs. 1 *b* and 2).

The test is perfectly smooth except upon the apertural inflation, where there are lines of growth in the shape of faint ridges regularly disposed, and having a curvature which corresponds with that of the margin of the aperture.

Dimensions.

	Large Specimen from Clane, in Science and Art Museum, Dublin.
Diameter of shell	149 mm.
„ umbilicus (edge to edge)	49 „
„ „ (suture to suture)	25 „
Height of whorl (dorso-ventral)	84 „
Thickness at centre of lateral area (without test)	92 „
„ aperture	82 „

Affinities.—The relationship between the present species and *Asymptoceras crassilabrum*, Foord, has been pointed out above in the description of the latter. It is more nearly related to *A. conspicuum*, de Kon.,[2] sp. But the latter, as observed by Hyatt,[3] is not so closely coiled, nor is the body-chamber produced beyond the earlier part of the last whorl, as in *A. Foordi.* The sutures also are more numerous and more sinuous in de Koninck's species than they are in Hyatt's.

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[1] Mr. G. C. Crick kindly supplied me with these measurements from the specimen in the British Museum, which I have figured.

[2] 'Faune Calc. Carb. Belg.,' pt. 1, p. 109, pl. xix, figs. 1 *a*—*e*; pl. xx; pl. xxi, figs. 1 *a*, *b*.

[3] 'Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report,' 1892, p. 459.

Remarks.—This species is only known to me from Clane, in the county of Kildare, and from Rathkeale, near the town of Limerick; but its presence in other localities in Ireland may very probably be demonstrated when the search for fossils becomes more systematic and wide-spread throughout the country. The quarries at Clane have yielded several specimens, whose aggregate features furnish all the data necessary for the full description of the species.

Localities.—Clane, county of Kildare; Rathkeale, near Limerick.

Genus Solenocheilus, *Meek and Worthen*, 1870 (emend. *Hyatt*, 1883, 1893).

Solenocheilus dorsalis, *J. Phillips*, sp. Plates XXXIII, XXXIV.

1836. Nautilus dorsalis, *J. Phillips*. Geology of Yorkshire, pt. 2, p. 231, ? pl. xvii, fig. 17; pl. xviii, figs. 1, 2.
1843. — — *J. E. Portlock*. Geology of Londonderry, p. 405.
1849. Cryptoceras dorsalis, *A. d'Orbigny*. Prodr. de Paléont. Stratigr., vol. i, p. 114.
1875. Nautilus dorsalis, *W. H. Baily*. Characteristic British Fossils, p. 117, pl. xl, fig. 7.
1876. — — *Armstrong, Young, and Robertson*. Catalogue of Western Scottish Fossils, p. 59.
1883. Asymptoceras dorsale, *A. Hyatt*. Genera of Fossil Cephalopods. Proceed. Boston Soc. Nat. Hist., vol. xxii, p. 297 (foot-note).
1891. Solenocheilus dorsalis, *A. H. Foord*. Cat. Foss. Ceph. British Museum, pt. 2, p. 169, fig. 27 (p. 166)—type specimen.
1893. — — *A. Hyatt*. Carboniferous Cephalopods. Second paper. Geological Survey of Texas, Fourth Annual Report, 1892, p. 460.

[Not 1878. *Nautilus dorsalis*, L. G. de Koninck. Faune Calc. Carb. Belg. (Ann. Mus. Roy. d'Hist. Nat. Belg., tom. ii), p. 111, pl. xxviii, figs. 1—3. (? var. γ of Phillips.)]

Description.—Shell large, nautilus-like, subglobose, consisting of about two rapidly enlarging involute whorls, the last overlapping the preceding one to the extent of about two-thirds. Umbilicus proportionately small, exposing the inner whorl, having a small central vacuity; the sides steep, with rounded margins which are merged in the sides of the shell. The section is broadly sagittate, the periphery forming the apex of the triangle.

The body-chamber is large, extending to about two-thirds of the circumference of the whorl. The periphery is somewhat narrowly rounded, the sides diverging outwardly from it, very slightly in the first whorl, but much more strongly in the

PLATE XVIII.[1]

TEMNOCHEILUS CORONATUS, *F. M'Coy.*

Fig. 1 *a*. Lateral view of the much-distorted type specimen figured by M'Coy ('Synop. Carb. Foss. Ireland,' pl. iv, fig. 15). 1 *b*. Front view of the same, the siphuncle obscurely seen above the centre of the septum. Little Island, Cork. Dublin Museum of Science and Art ("Griffith Collection"). (Page 49.)

Fig. 2 *a*. Lateral view of the inner whorls of a fine specimen collected by Mr. E. J. Garwood, F.G.S., at Stebden Hill, near Cracoe, Yorkshire. The specimen is now in the British Museum, and is here re-figured for comparison with M'Coy's specimen, which still remains unique in Ireland. (Page 49.)

TRIGONOCERAS PARADOXICUM, *J. de C. Sowerby*, sp.

Fig. 3 *a*. Lateral view of a specimen covered with the test, and showing the fine ridge near the peripheral border. 3 *b*. Longitudinal section of the posterior portion of the same, showing the septa and siphuncle which have been displaced and distorted by crystallisation. The darkly shaded part above is the lower portion of the body-chamber. 3 *c*. Diagrammatic cross-section of 3 *a*. Clane. Dublin Museum of Science and Art. (Page 51.)

Fig. 4 *a*. Dorsal or antiperipheral view of another specimen, showing the prominent longitudinal keel and the faint ridges on each side of it. 4 *b*. Peripheral view of the same, showing strong marginal keels and the septa very faintly discernible. Kildare (probably Clane). British Museum. (Page 51.)

Fig. 5. Outline of colour-bands on a specimen from Clane, in the Public Museum, Belfast. The vertical line indicates the dorsal keel. (Page 51.)

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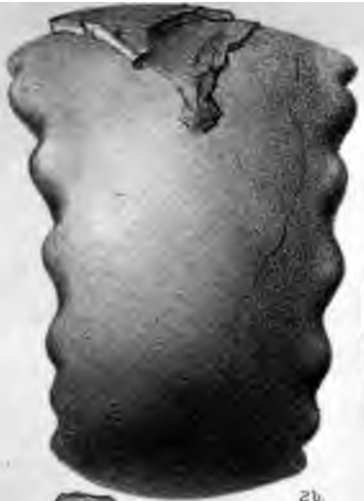
[1] The figures in this and the following Plates represent the specimens of the natural size unless the contrary is stated.

PLATE XVIII.



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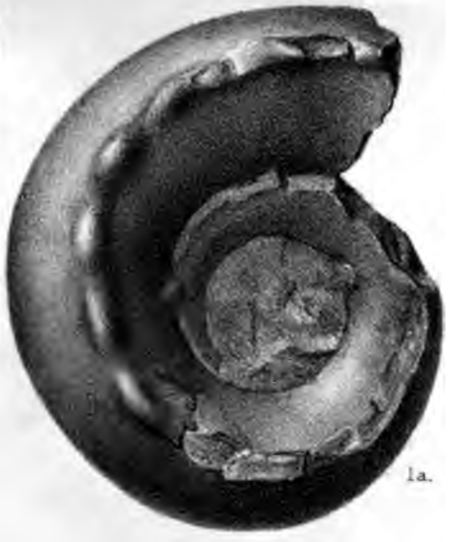

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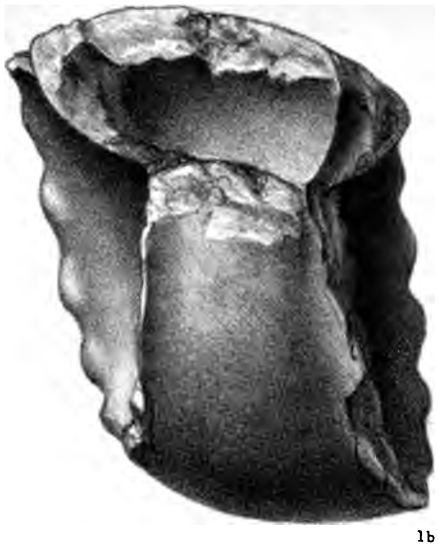

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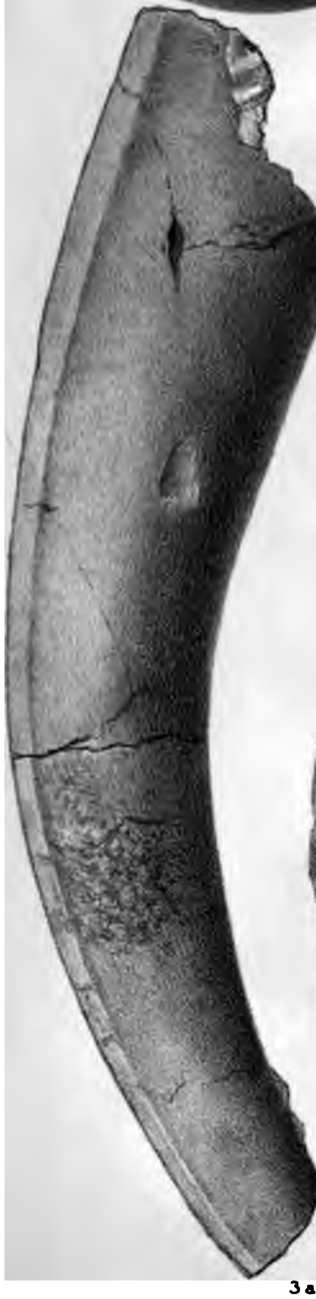

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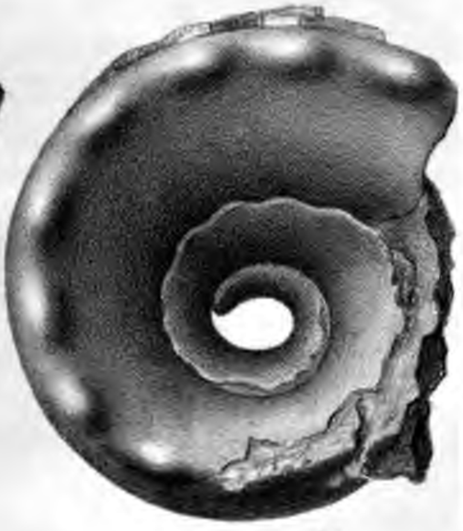

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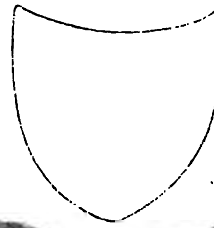

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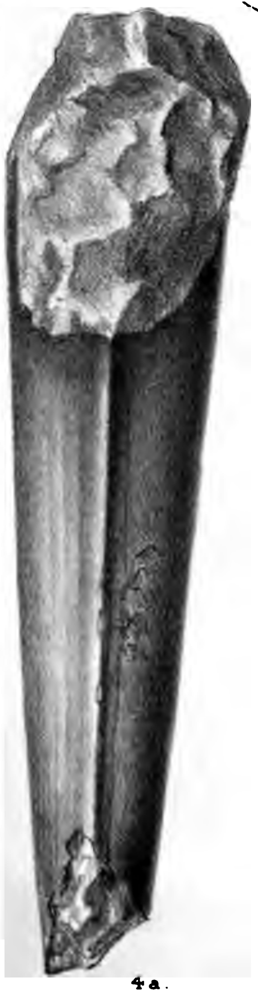

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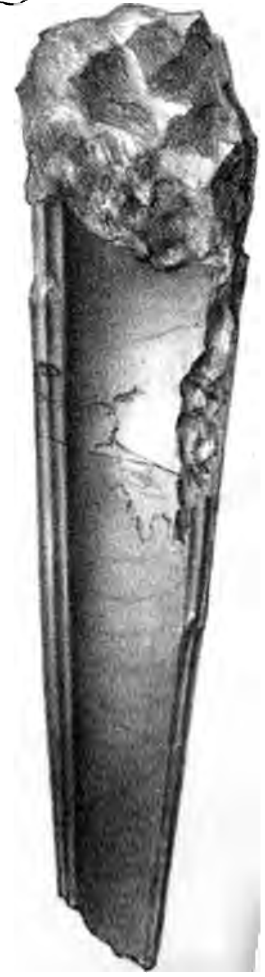

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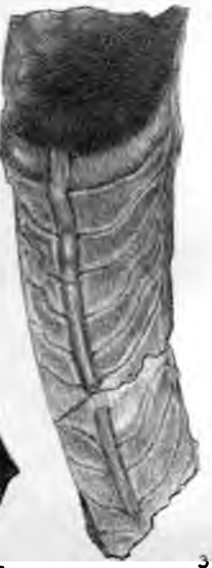

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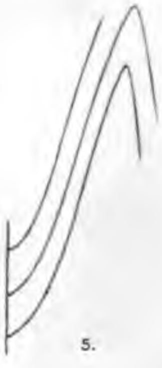


5.

.Brock del.
J.Crowther lith.

West.Newm

PLATE XIX.

Cœlonautilus planotergatus, *F. M'Coy*, sp.

Fig. 1 *a*. Lateral view of the distorted and imperfect specimen figured by M'Coy in the 'Synopsis' (pl. ii, fig. 2). 1 *b*. Peripheral view of the same, showing the sutures of the septa. Cork (near the city). Dublin Museum of Science and Art ("Griffith Collection"). (Page 53.)

Fig. 2 *a*. Part of inner whorl of another specimen, showing sutures of the septa. 2 *b*. Part of penultimate whorl of the same, showing the impressed zone, with the mark of the sutures of the inner whorl, which it overlaps. 2 *c*. Diagrammatic section showing the position of the siphuncle. Rathkeale. Dublin Museum of Science and Art (Geological Survey Collection). (Page 53.)

Cœlonautilus Doohylensis, sp. nov.

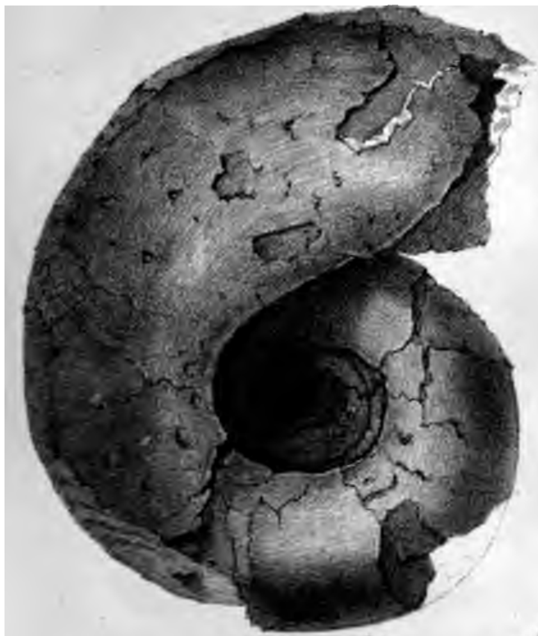
Fig. 3 *a*. Lateral view of an imperfect specimen. 3 *b*. Peripheral view of the same, showing the fine ridges. 4 *a*. View of the septal surface of another individual, showing the position of the siphuncle. 4 *b*. Profile view of the same. Doohyle. Dublin Museum of Science and Art. (Page 56.)

Planetoceras globatum, *J. de C. Sowerby*, sp.

Fig. 5 *a*. Lateral view of an adult individual. 5 *b*. Front aspect of the same. About three-fourths of the natural size. "Kildare" (probably Clane). British Museum. (Page 96.)

Fig. 6. Lateral view of a young and perfect individual. St. Doulagh's. My Collection. (Page 96.)

PLATE XIX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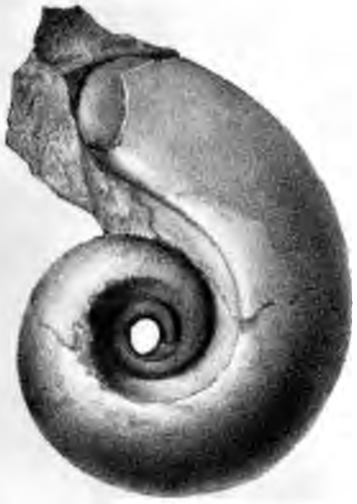
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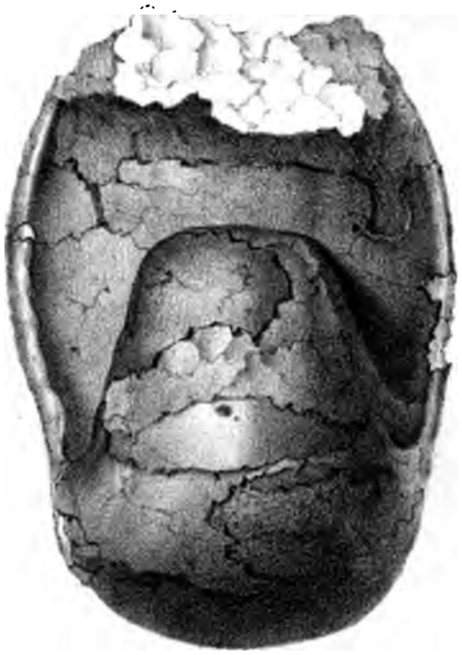
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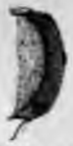
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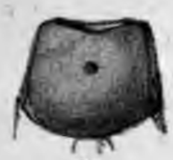
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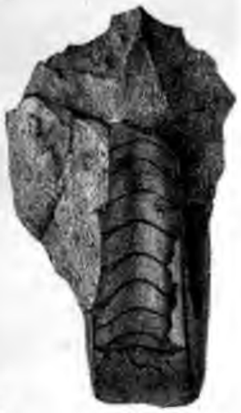
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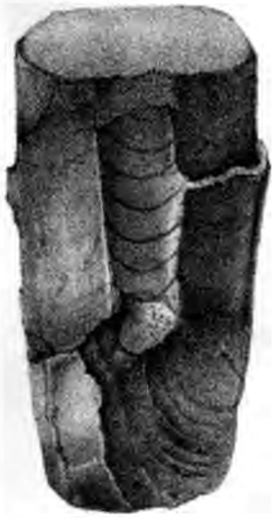
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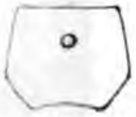
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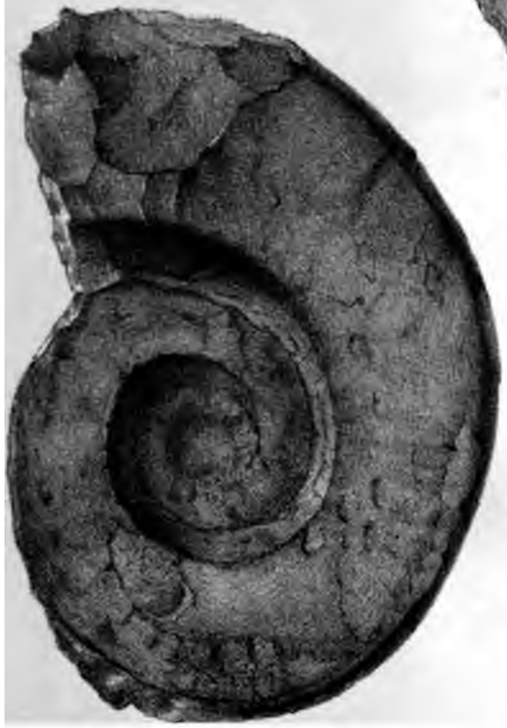
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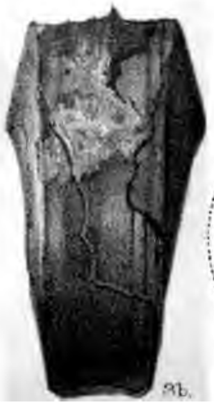
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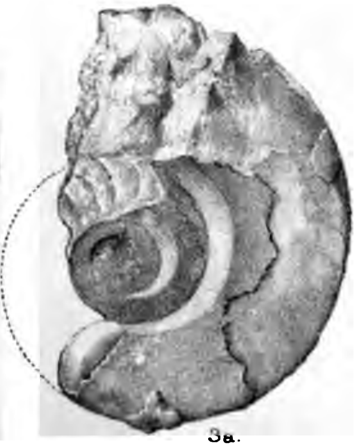
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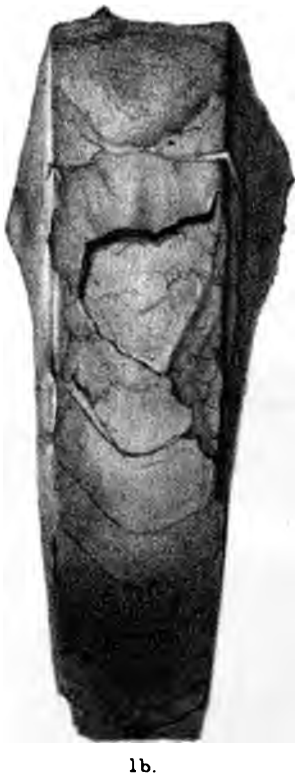

1b.

West,Newman

PLATE XX.

CŒLONAUTILUS GRADUS, *A. H. Foord*.

Fig. 1 *a*. Lateral aspect of an adult and nearly perfect individual, showing **the faint folds on the** sides of the inner whorls. 1 *b*. Part of the periphery of **another specimen, showing the longitudinal** ridges. Kildare. British Museum. (Page 57.)

Fig. 2. Polished section of another individual, showing the **septa and siphuncle, and almost the** whole of the body-chamber. Kildare. British Museum. (Page 57.)

Fig. 3. Peripheral view of an individual in which strong nodular folds are **developed as well as** ridges; the edge of the aperture is seen. Curraghbridge. Dublin **Museum of Science and Art** (Geological Survey Collection). (Page 57.)

Fig. 4. View of the inner whorls of another individual, showing **their quadrate form and the** position of the siphuncle. Rathkeale. Dublin Museum of Science and Art (**Geological Survey** Collection). (Page 57.)

The following are considered to be the young of this species; **they are all from Rathkeale and are** contained in the Dublin Museum of Science and Art.

Fig. 5. Lateral aspect of a specimen, showing the slight folds on the **inner whorls (cf. Fig. 1 *a*)**. (Page 57.)

Fig. 6. Peripheral view of a specimen, showing the outline of the **aperture, and some of the fine** and sharp longitudinal ridges. (Page 57.)

Fig. 7 *a*. Lateral view of a specimen, showing the sutures of the **septa. 7 *b*. Front view of the** same individual. (Page 57.)

Fig. 8 *a*. Lateral aspect of a specimen, showing the minute **crenulations on the peripheral and** umbilical edges (the drawing necessarily makes them appear **coarser than they are in nature**). **8 *b*.** Part of the peripheral area of the same individual, showing **the fine longitudinal ridges, and the** sinuous lines which indicate the position of former apertures **of the shell. (Page 57.)**

Fig. 9 *a*. Part of the outer and inner whorls of a specimen, showing **their quadrate form and the** position of the siphuncle. 9 *b*. Part of the inner whorls of the **same individual, the smaller showing,** with the aid of a lens, fine longitudinal lines (indicated in the figure), as well as **minute transverse** lines too fine to be represented. (Page 57.)

STROBOCERAS SULCATUM, *J. de C. Sowerby*, sp.

Fig. 10 *a*. Lateral aspect of a specimen, showing the ornamentation. **10 *b*. Peripheral view of the** same. Little Island, near Cork. Dublin Museum of Science and Art. (**Page 60.**)

Fig. 11. Lateral view of a distorted but well-preserved individual, showing the **apical point and** ornamentation. Little Island, near Cork. Dublin Museum of Science and **Art. (Page 60.)**

Fig. 12. Lateral aspect of a very imperfect specimen, showing the septa. **Mullaghfarry, Killala.** Dublin Museum of Science and Art ("Griffith Collection"). (**Page 60.**)

STROBOCERAS CRASSUM, sp. nov.

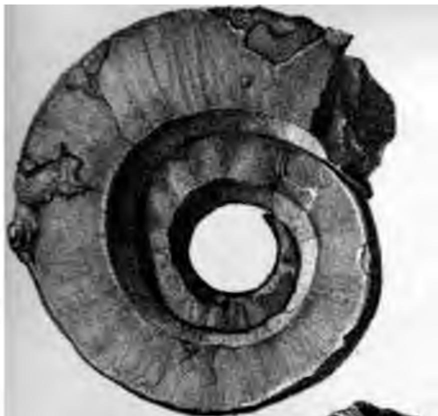
Fig. 13 *a*. Lateral view of a fragment of the body-chamber, showing the ridges and **sulci. 13 *b*.** View of the periphery of the same, showing the superiority of its breadth to that of ***Stroboceras* *sulcatum***. 13 *c*. Transverse section of the same in outline. Ring, near **Enniskillen. Dublin Museum** of Science and Art ("Griffith Collection"). (Page 64.)

MESOCHASMOCERAS LATIDORSATUM, *F. M'Coy*, sp.

Fig. 14 *a*. Lateral view of a nearly perfect specimen. 14 *b*. Portion of the same, showing the sutures of the septa. Argoul South. Dublin Museum of Science and Art (Geological Survey Collection). (Page 73.)

Fig. 15 *a*. Another specimen, imperfect at both extremities. 15 *b*. View of the periphery of the same, showing the fine ridges near its margins. 15 *c*. Body-chamber (fragment) of the same, detached from the septate part of the shell, showing the zone of impression and the form of the whorls as seen in transverse section. 15 *d*. Another piece of the same specimen, showing part of the innermost whorl and the position of the siphuncle. Cragard. Dublin Museum of Science and Art (Geological Survey Collection). (Page 73.)

PLATE XX.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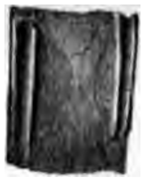
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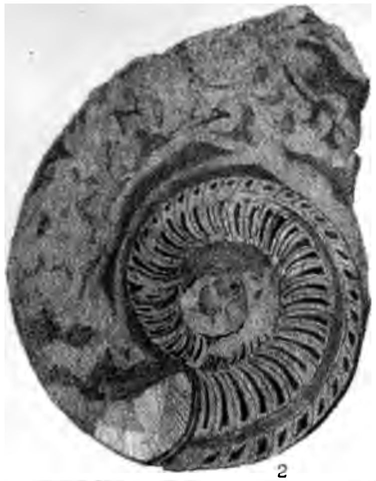
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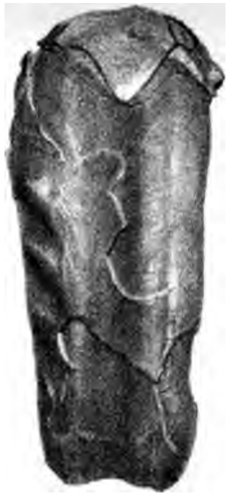
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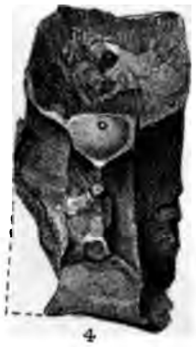
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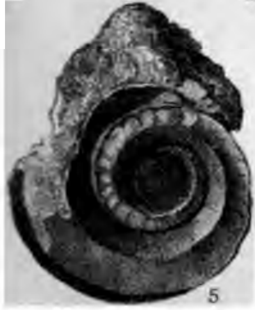
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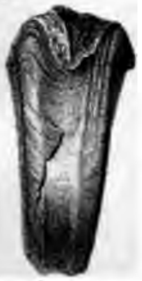
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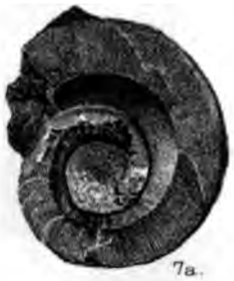
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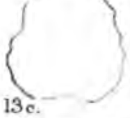
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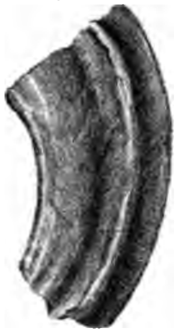
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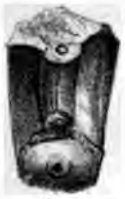
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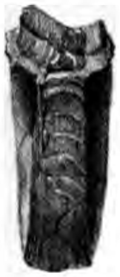
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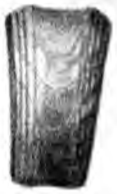
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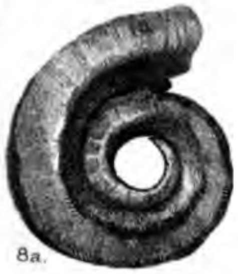
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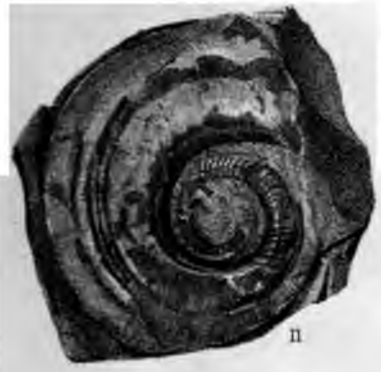
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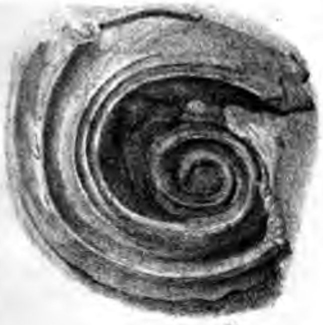
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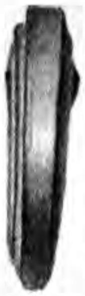
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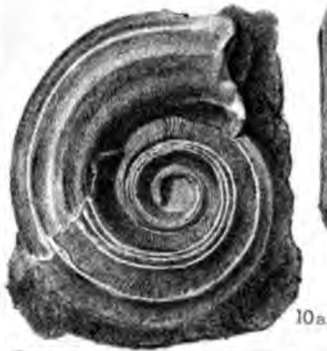
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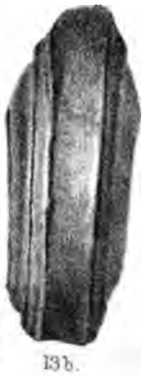
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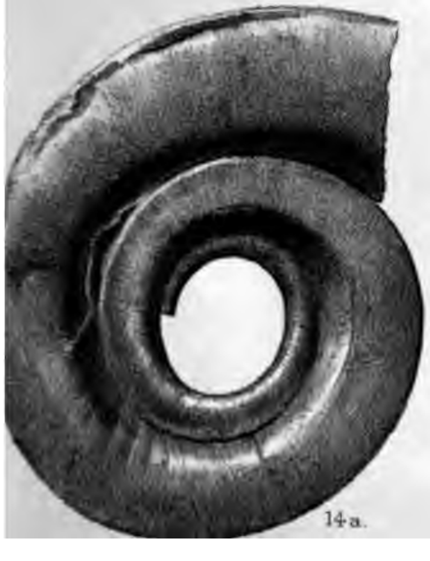
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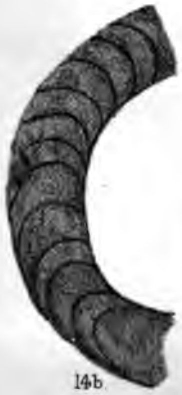
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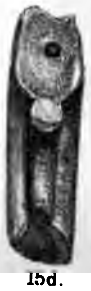
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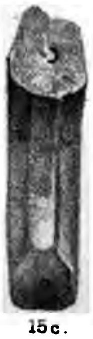
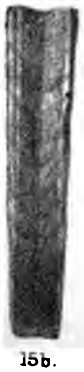

15c.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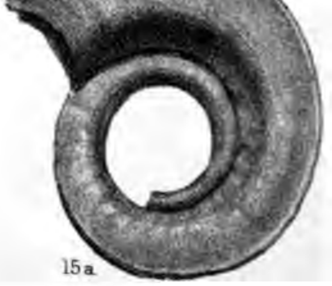

15a.

West, Newman lith.

PLATE XXI.

APHELECERAS MUTABILE, *F. M'Coy*, sp.

Fig. 1 *a*. Lateral view of an imperfect specimen. 1 *b*. Peripheral view of the same, showing the lines of growth. Somewhat reduced in size. Kildare (probably Clane). British Museum (No. C. 134). (Page 65.)

Fig. 2 *a*. Transverse section of whorl of another specimen, showing position of siphuncle. 2 *b*. Part of inner whorl of the same, showing fine longitudinal lines. 2 *c*. Part of initial whorl of the same. Clane. Dublin Museum of Science and Art. (Page 65.)

Fig. 3. Polished section, showing the septa and siphuncle. Clane. Dublin Museum of Science and Art. (Page 65.)

APHELECERAS HIBERNICUM, *A. H. Foord and G. C. Crick*, sp.

Fig. 4 *a*. Lateral aspect of a nearly perfect specimen (figured 'Geological Magazine,' loc. cit.). 4 *b*. Peripheral aspect of the same. 4 *c*, 4 *d*. Details of the ornamentation somewhat enlarged: 4 *c*, that of the periphery; 4 *d*, that of part of the inner whorl at the bend near the apex. St. Doulagh's. British Museum. (Page 68.)

Fig. 5. Lateral view of a nearly perfect specimen, with the ornamentation completely preserved. St. Doulagh's. Dublin Museum of Science and Art. (Page 68.)

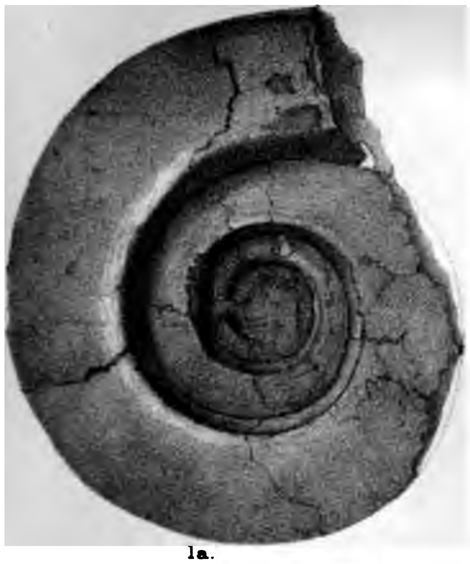
Fig. 6. Fragment of another individual, polished to show the septation. St. Doulagh's. Dublin Museum of Science and Art. (Page 68.)

Fig. 7 *a*. Fragment of the body-chamber of a large individual, with a considerable part of the test, well preserved and showing fine lines of growth, which become coarser near the aperture (top of figure). 7 *b*. Lower extremity of the same, showing the position of the siphuncle. St. Doulagh's. British Museum. (Page 68.)

VESTINAUTILUS CARINIFERUS, *J. de C. Sowerby*, sp.; var. MAGNICAMERATUS, var. nov.

Fig. 8. Peripheral view of a distorted specimen, showing the wide septation (cf. Plate XXIII, fig. 2). Limerick (exact locality unknown, probably near the city). Dublin Museum of Science and Art. (Page 84.)

PLATE XXI.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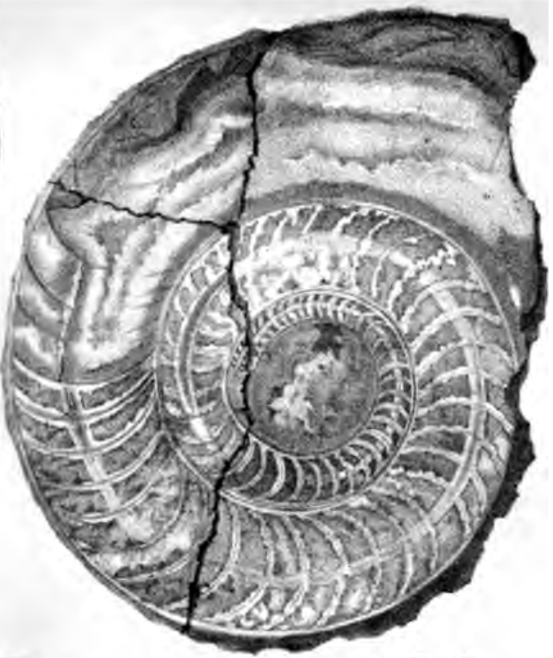
1b

2a.

2c.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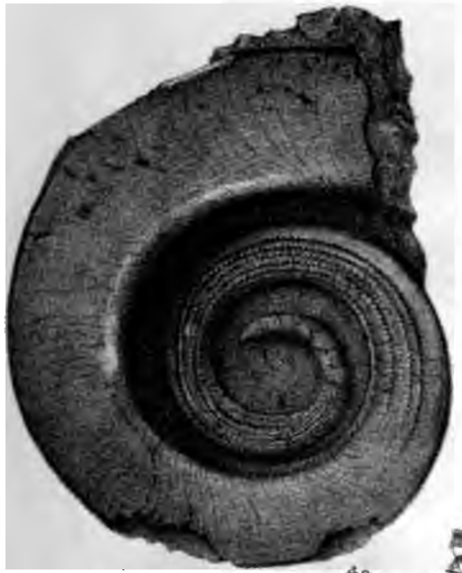
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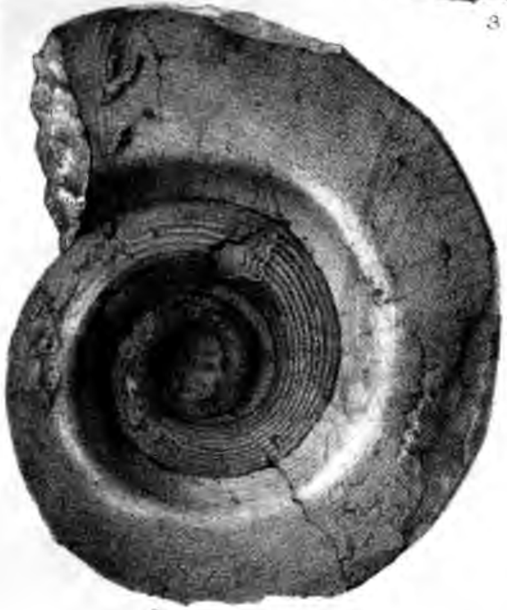
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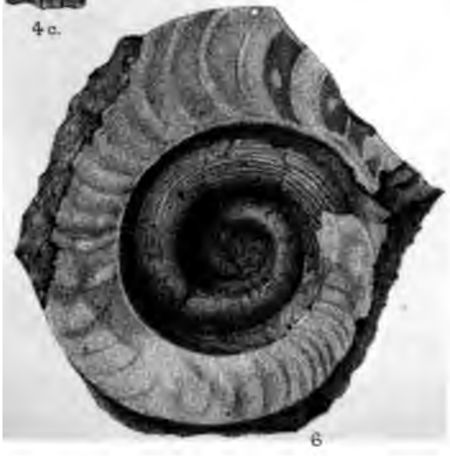
7a

4d.

4c.

4b.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8

7b

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PLATE XXII.

TRIBOLOCERAS FORMOSUM, sp. nov.

Fig. 1. Lateral view of a large imperfect specimen, showing the prominent, spiral, crenulated ridges. Lisbane. Dublin Museum of Science and Art (Geological Survey Collection). (Page 75.)

Fig. 2. Peripheral view of a young individual, showing the strong ridges and deep furrows. Garrihies (Kerry). Dublin Museum of Science and Art (Geological Survey Collection). (Page 75.)

VESTINAUTILUS SEMIGLABER, sp. nov.

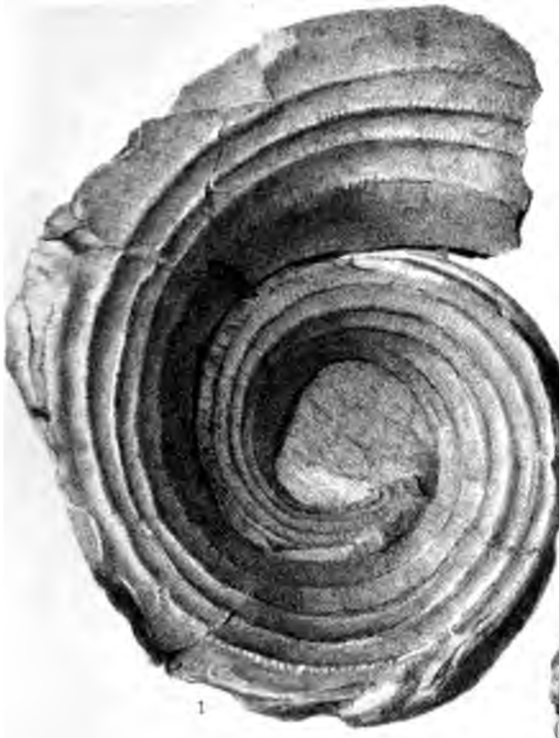
Fig. 3. Lateral view of an adult (?) individual with most of the body-chamber present, and showing the highly crenulated lateral ridges and the smooth area facing the umbilicus. Lisbane. Dublin Museum of Science and Art (Geological Survey Collection). (Page 78.)

Fig. 4 *a*. Lateral view of a younger individual, showing (too indistinctly in the figure) the septa on the inner whorls. (The outline of this figure is a little distorted; this is erroneous, as the specimen is perfectly symmetrical.) 4 *b*. Peripheral view of the same, showing rather faint ridges. 4 *c*. Transverse section (diagrammatic—the two oblique lines at the lower part of the figure representing the smooth area are made a little too short). Lisbane. Dublin Museum of Science and Art (Geological Survey Collection). (Page 78.)

VESTINAUTILUS CRASSIMARGINATUS, sp. nov.

Fig. 5 *a*. Lateral view of a large and nearly perfect individual, showing the heavy rim bordering the umbilicus and the fine and regular lines of growth covering the test. 5 *b*. Front view of the same. (Note the curvature of the lines of growth in crossing the periphery.) 5 *c*. Diagrammatic transverse section, showing the position of the siphuncle. Little Island. Dublin Museum of Science and Art. (Page 79.)

PLATE XXII.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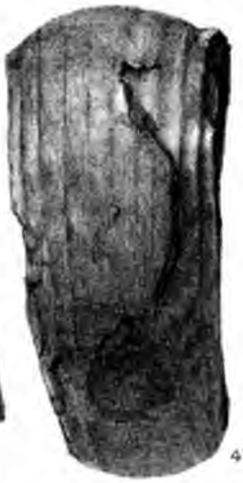
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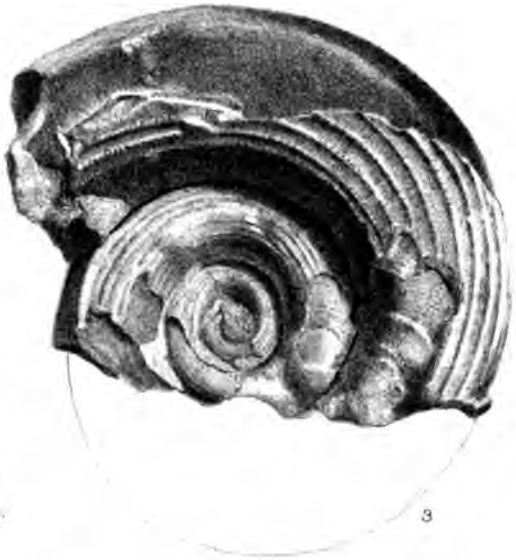
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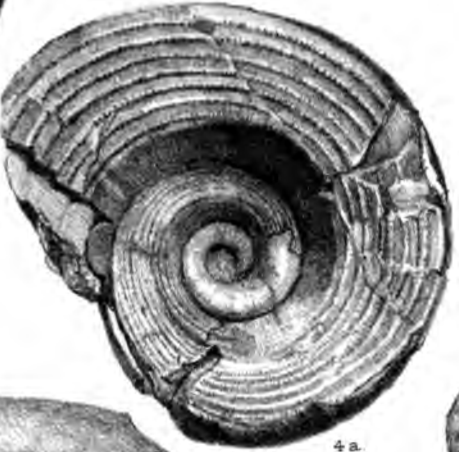
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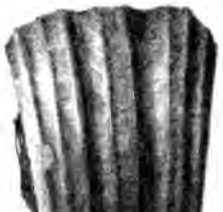
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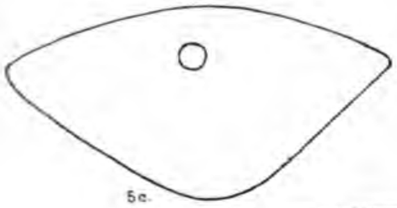
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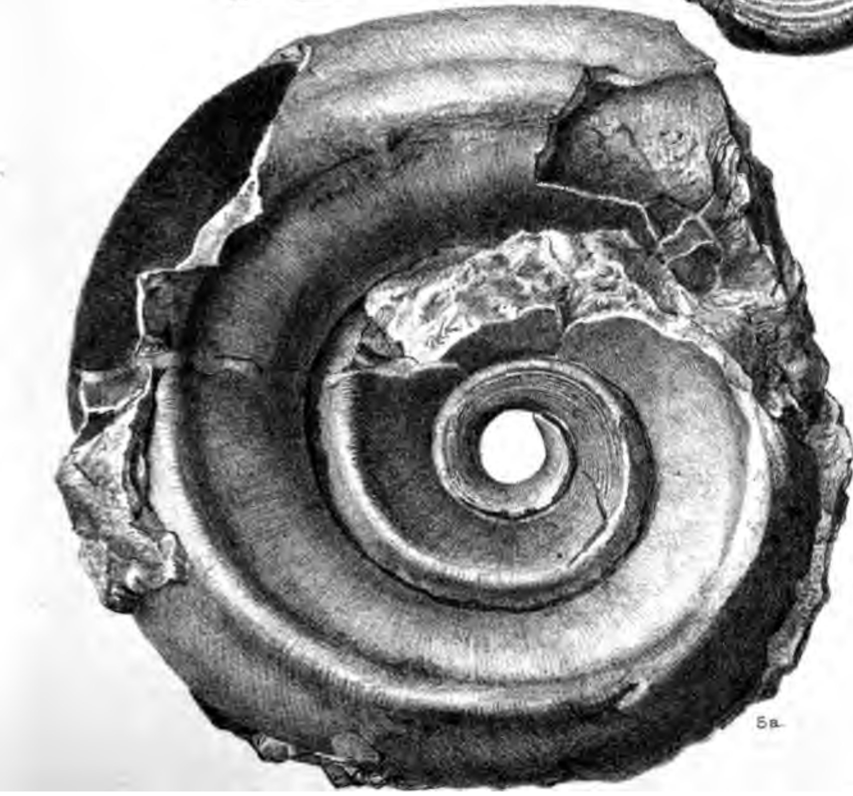
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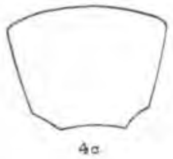
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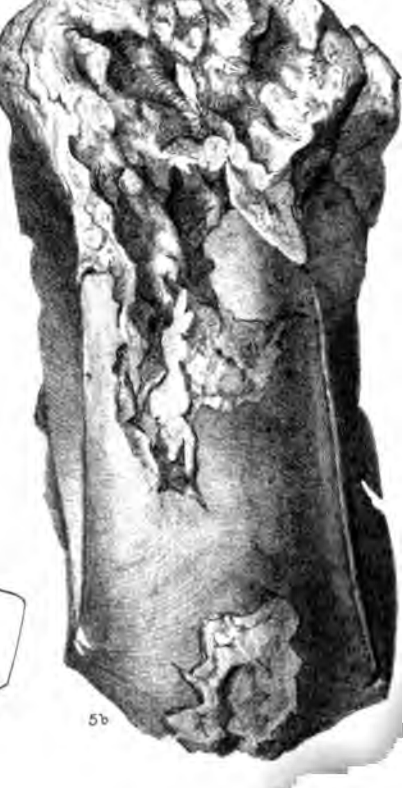
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We

PLATE XXIII.

VESTINAUTILUS CARINIFERUS, *J. de C. Sowerby*, sp.

Fig. 1 *a.* Lateral view of a perfect specimen, showing the strong keel bordering the umbilicus, hidden in the inner whorls. 1 *b.* Front view of the same, showing faint ridges which divide the periphery longitudinally into three distinct areas. Clane. Dublin Museum of Science and Art. (Page 82.)

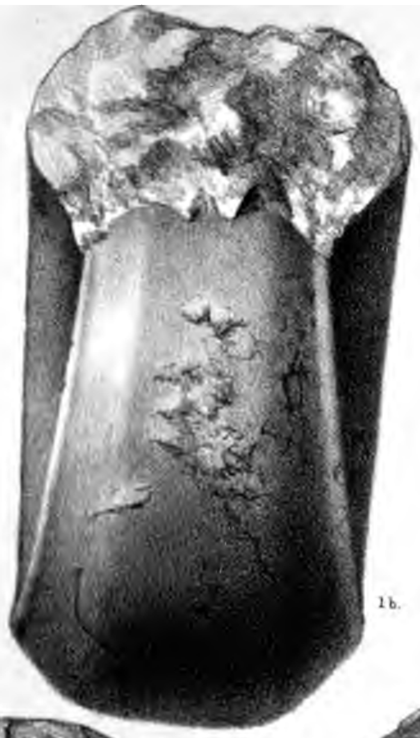
Fig. 2. Lateral view of a specimen showing the septation, some of the test still adhering to the cast. St. Doulagh's. Dublin Museum of Science and Art. (Page 82.)

Fig. 3. Front view of a young specimen with remarkably strong peripheral keels. Ardtomin, county of Limerick. Dublin Museum of Science and Art (Geological Survey Collection). (Page 82.)

VESTINAUTILUS CRATERIFORMIS, sp. nov.

Fig. 4 *a.* Lateral view, showing septate part and most of the body-chamber; some of the test remains. 4 *b.* Front view, showing the arched conformation of the sutures in crossing the periphery. 4 *c.* View of the base of the body-chamber, showing the position of the siphuncle, also the annular or dorsal lobe of the sutures. Glenbane West, county of Limerick. Dublin Museum of Science and Art (Geological Survey Collection). (Page 85.)

PLATE XXI



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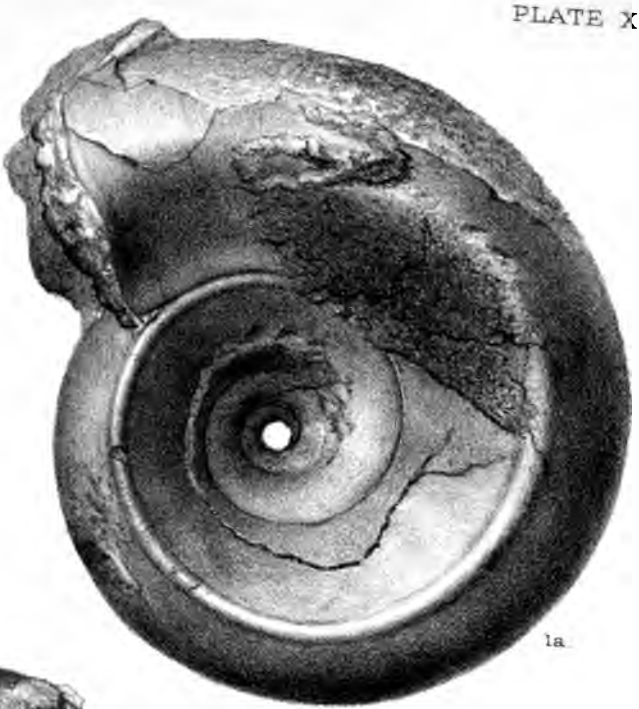

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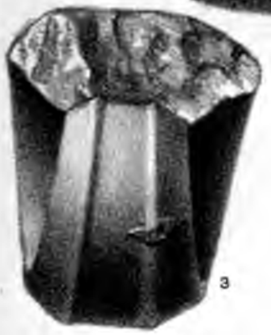

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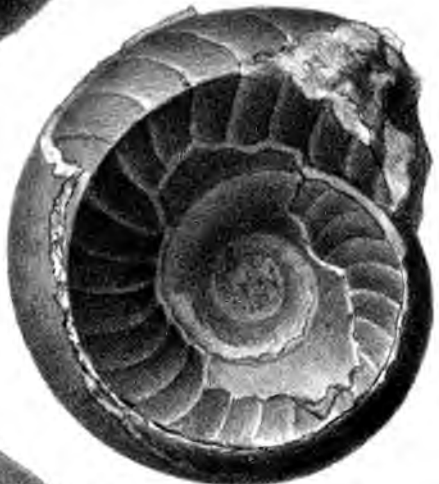

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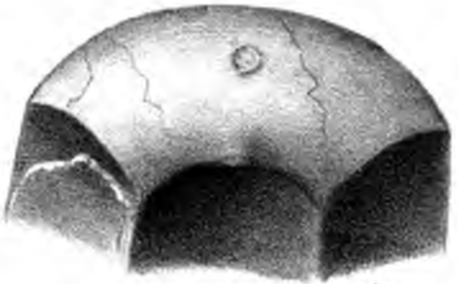
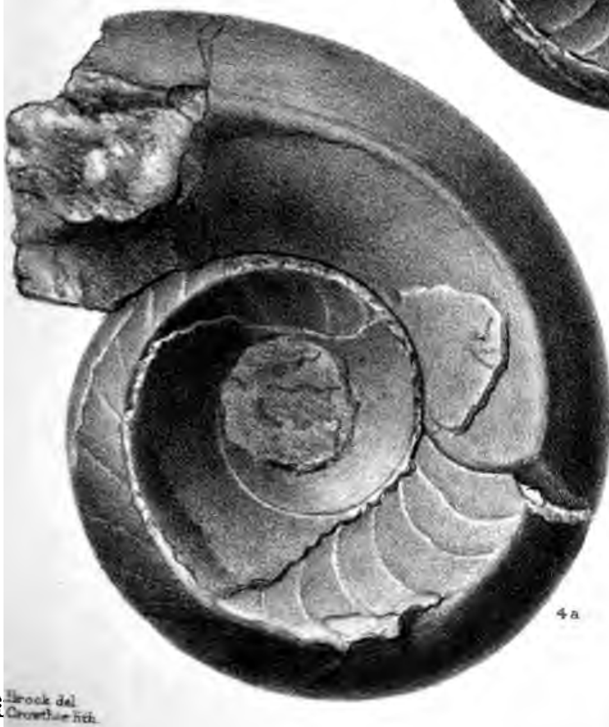


4 c.



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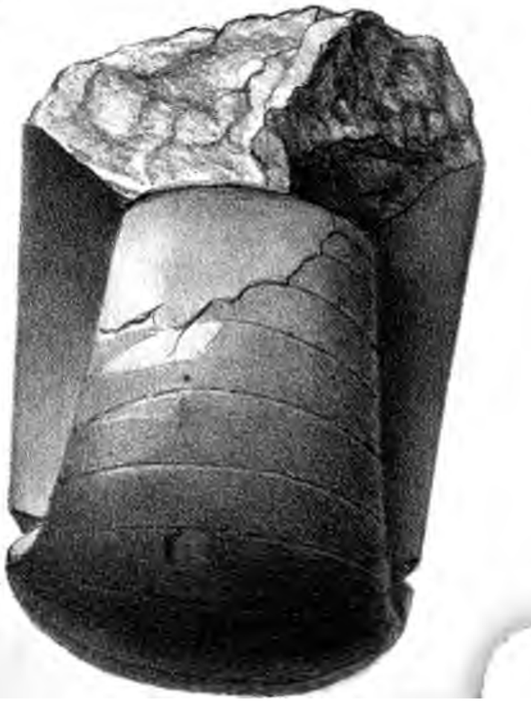


4 b.

T.A. Brock del.
H. Crowther lith.

West, Newman

PLATE XXIV.

VESTINAUTILUS PAUCICARINATUS, *A. H. Foord*, sp.

Fig. 1 *a*. Lateral view of a nearly perfect specimen, showing the characteristic inner keel of this species 1 *b*. Front view, showing the peripheral keels. Ireland (exact locality unknown). British Museum. (Page 86.)

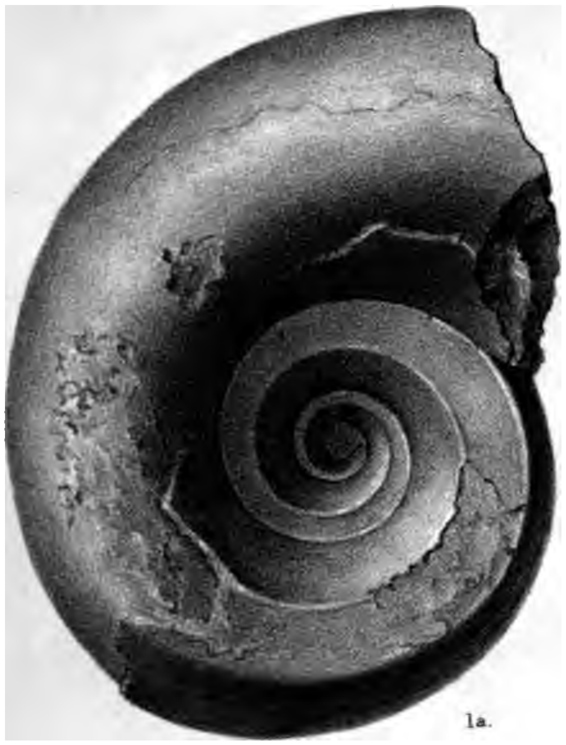
Fig. 2. Front view of a large specimen, showing the close septation upon the peripheral area. Glenbane West, county of Limerick. Dublin Museum of Science and Art (Geological Survey of Ireland). (Page 86.)

Fig. 3. Polished section of an individual, showing the septa and siphuncle and the greater part of the body-chamber. St. Doulagh's. My Collection. (Page 86.)

Fig. 4. Lateral view of a young individual. St. Doulagh's. Dublin Museum of Science and Art. (Page 86.)

Fig. 5. Ornamentation of the test of another specimen, enlarged; this is rarely preserved. (The lines in this figure are proportionally too fine; they are also too irregular.) St. Doulagh's. Dublin Museum of Science and Art. (Page 86.)

PLATE XXIV.



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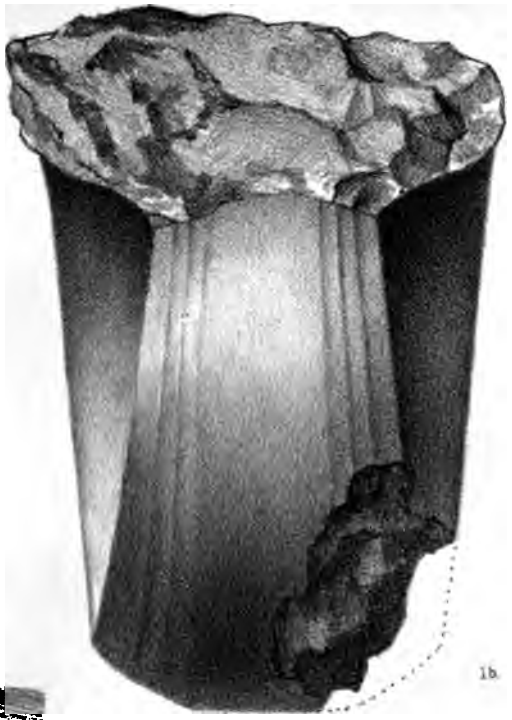
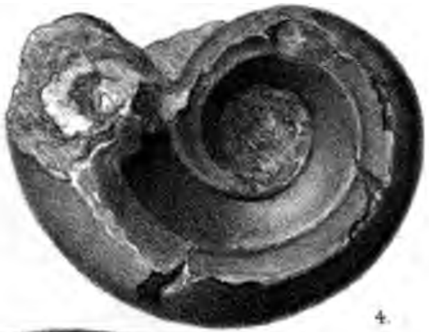


1b.

5.



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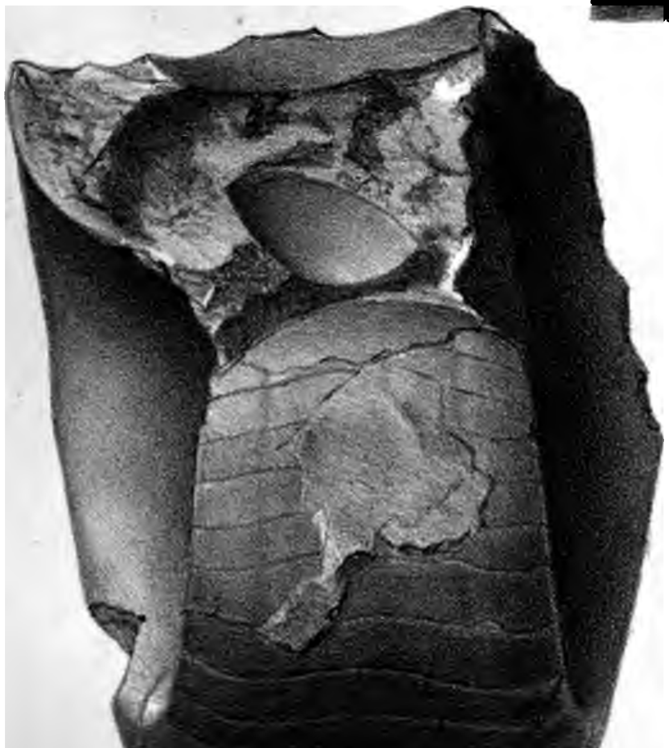

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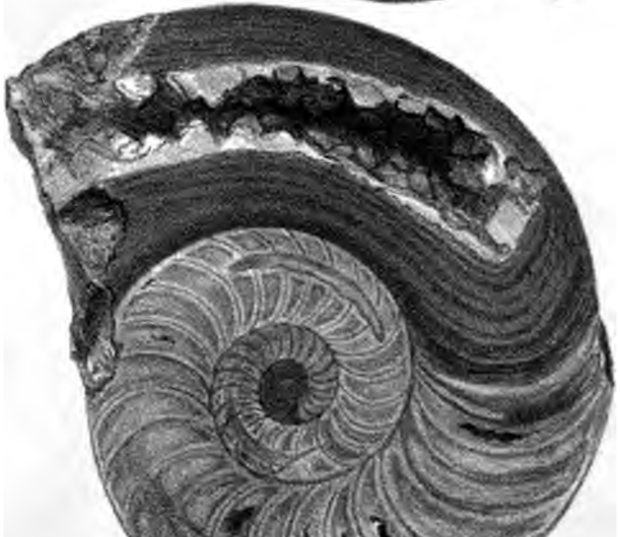


3.

T.A.Brock del.
W.H.Crowther lith.

West, Ne

PLATE XXV.

VESTINAUTILUS SEMIPLICATUS, sp. nov.

Fig. 1 *a*. Lateral view of a nearly perfect specimen, showing the cast of the body-chamber, the test having been mostly stripped off. 1 *b*. View of the periphery of the same, showing the tubercles and the strong fold; the outline of the aperture is seen above. Rathkeale. Dublin Museum of Science and Art. (Page 91.)

Fig. 2 *a*. Lateral view of supposed young individual of the same species. 2 *b*. Peripheral view of the same, showing very strong keels. Rathkeale. Dublin Museum of Science and Art (Geological Survey Collection). (Page 91.)

VESTINAUTILUS PINGUIS, *L. G. de Koninck*, sp.

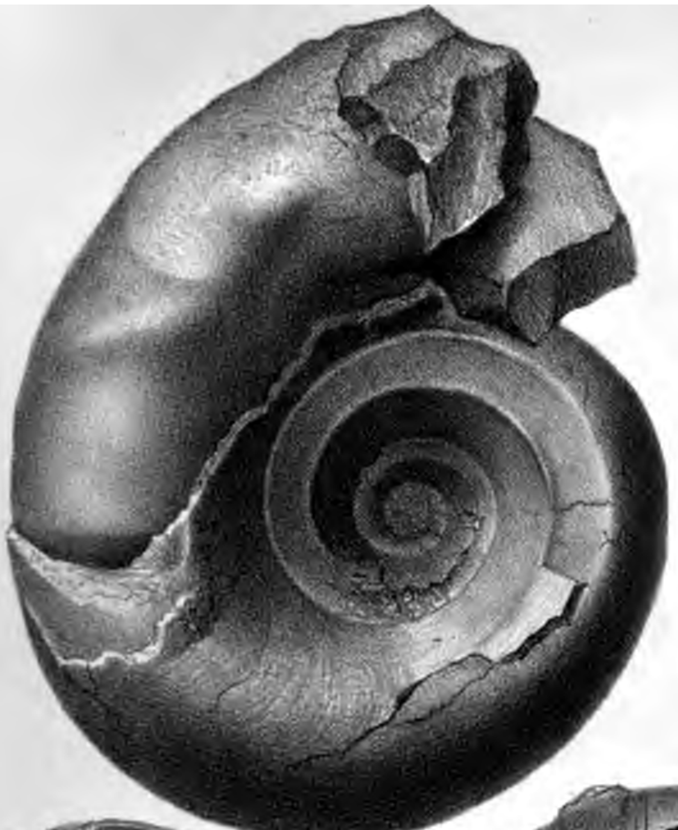
Fig. 3 *a*. Lateral aspect of the septate part of a well-preserved individual. 3 *b*. Peripheral view of the same, showing faint ridges on the cast. Limerick (probably near the city). Dublin Museum of Science and Art. (Page 89.)

VESTINAUTILUS MULTICARINATUS, *J. de C. Sowerby*, sp.

Fig. 4 *a*. Lateral aspect of an imperfect specimen. 4 *b*. Peripheral aspect of the same, showing the numerous keels. Ireland (exact locality unknown). British Museum (No. 50,192). (Page 93.)

Fig. 5. Fragment showing the apical part of the initial whorl. Ireland (exact locality unknown). Museum of Trinity College, Dublin. (Page 93.)

PLATE XI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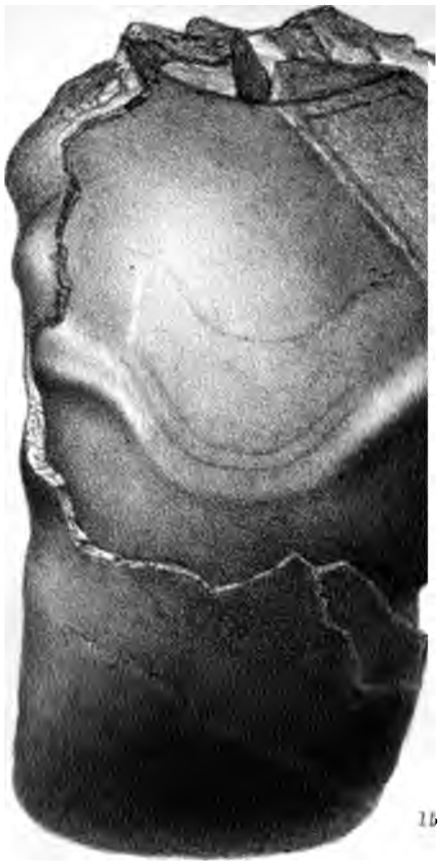
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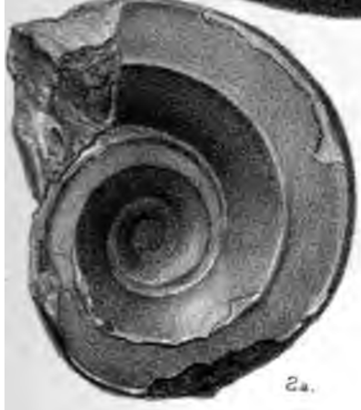
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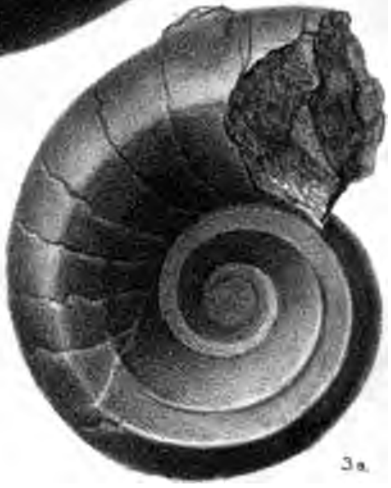
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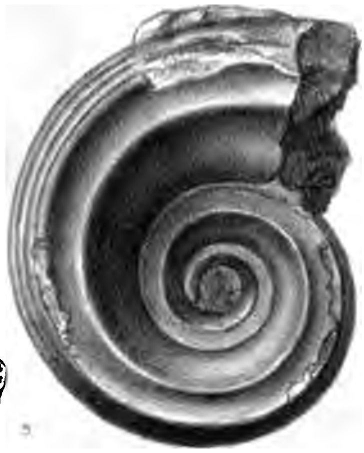
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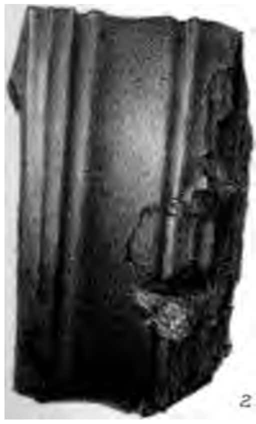
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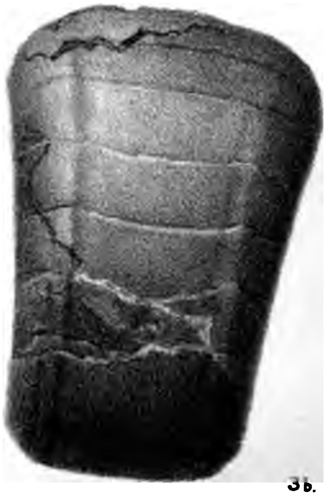
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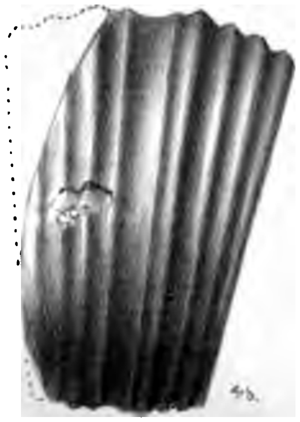

4b.

West, Newman

PLATE XXVI.

THRINCOCERAS HYATTI, sp. nov.

Fig. 1 *a*. Peripheral view of a specimen. 1 *b*. Lateral view of the same, showing the fine ridges covering the whole of the shell. 1 *c*. Part of another specimen, showing the impressed zone, also ridged. 1 *d*. Ornamentation (from 1 *b*, the side of the shell) enlarged about twelve times. 1 *e*. The same slightly enlarged. 1 *f*. The same in the very young shell. 1 *g*. Septum of another specimen, showing position of siphuncle. St. Doulagh's. Museum of the Royal College of Science for Ireland, Dublin, except 1 *g*. (Page 98.)

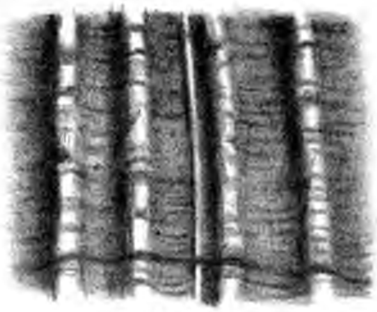
THRINCOCERAS HIBERNICUM, *A. H. Foord*, sp.

Fig. 2 *a*. Lateral aspect of an imperfect specimen, showing the septa of the inner whorls. 2 *b*. Peripheral view of the same, showing the lines of growth crossing it in a sinuous manner. Glenbane. Dublin Museum of Science and Art (Geological Survey Collection). (Page 101.)

DISCITOCERAS WRIGHTII, sp. nov.

Fig. 3 *a*. Lateral view of an imperfect but undistorted specimen, showing the ornamentation. Midleton. Dublin Museum of Science and Art. 3 *b*. Lateral view of a distorted specimen, showing some of the coarser lines of growth. 3 *c*. Section, transversely to the whorls, of another specimen, showing the position of the siphuncle. 3 *d*. Bead-like ornamentation taken from 3 *a*. Little Island. Dublin Museum of Science and Art. (Page 105.)

1a.


1d. × 12

1b.

1e.

1g.

1f.

3c.

2a.

2b.

1c.

3a.

3d.

3b.

PLATE XXVII.

DISCITOCERAS LEVEILLEANUM, *L. G. de Koninck*, sp.

Fig. 1 *a*. Lateral view of a young and perfect individual, somewhat distorted; the margin of the aperture is seen, and the lines of growth near it are very distinct. (The light spots near the margin of the whorl, above the break in the shell, are of no significance.) 1 *b*. Front view of the same specimen. Clane. Dublin Museum of Science and Art. (Page 102.)

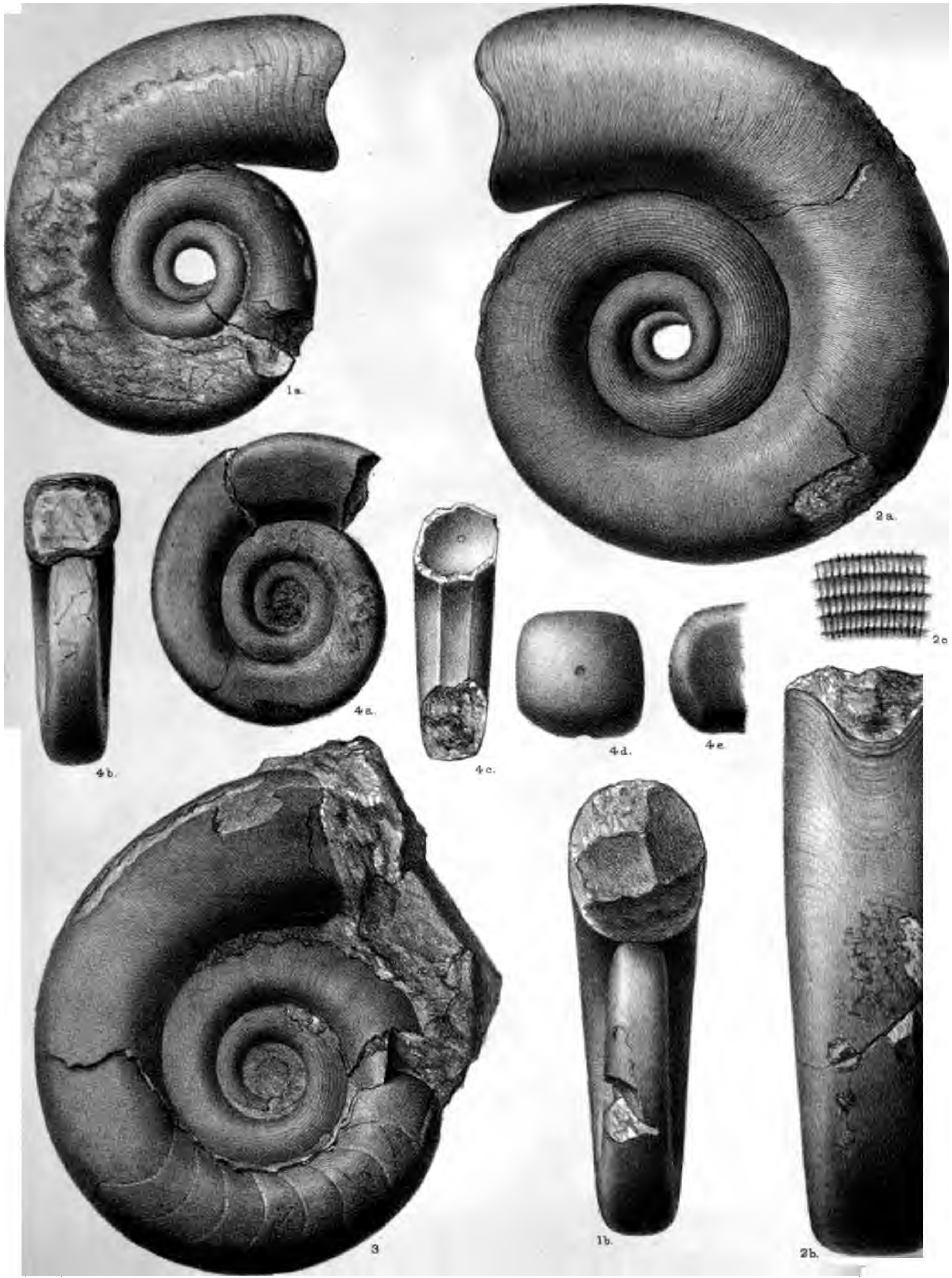
Fig. 2 *a*. Lateral view of a remarkably fine and perfect individual, slightly distorted; the figure shows well the fine and regular lines of growth, and the fine longitudinal ridges extending to the beginning of the last whorl. 2 *b*. Peripheral view of the same specimen, showing the deep sinus in the margin of the aperture. 2 *c*. Ornamentation of the penultimate whorl enlarged. Clane. Dublin Museum of Science and Art. (Page 102.)

Fig. 3. Lateral view of an undistorted specimen, showing part of the septation and the whole of the body-chamber. Ballyhomon. Dublin Museum of Science and Art (Geological Survey Collection). (Page 102.)

? DISCITOCERAS DISCORS, *F. M'Coy*, sp.

Fig. 4 *a*. Lateral view of a specimen wanting a considerable part of the body-chamber; its base is where the fracture is shown. 4 *b*. Front view of the same. 4 *c*. Part of the last whorl of the same specimen extending to the base of the body-chamber, showing the zone of impression and the position of the siphuncle. (These figures are reduced to about two-thirds of the natural size.) 4 *d*. View of a septum (natural size), showing the position of the siphuncle and the annular lobe. 4 *e*. Profile view of the same. Ballygarrane. Dublin Museum of Science and Art. (Page 104.)

PLATE XXV



T.A.Brock del.
W.H.Crowther lith.

PLATE XXVIII.

ACANTHONAUTILUS BISPINOSUS, *A. H. Foord.*

Fig. 1. Front view of the only individual yet found, showing the spine on the right-hand side; the shaded one on the other side is a "restoration," put in merely to balance the figure. The sutures of the septa are seen on the right-hand side of the figure (see also Pl. XXIX). Clane. Dublin Museum of Science and Art. (Page 118.)

VESTINAUTILUS CARINIFERUS, *J. de C. Sowerby*, sp.; var. TRIPLICATUS, var. nov.

Fig. 2 *a*. Lateral view of the only specimen collected, showing upon the test near the aperture two strong plications, with part of a third, the latter almost entirely removed with the test of which it formed part. 2 *b*. Peripheral view of the same individual, showing the "Runzelschicht," and the fine, somewhat regular lines of growth. The plications are shown on the left-hand side of the figure. The emargination above represents the sinus in the aperture. (Owing partly to the way in which the specimen was drawn with reference to illumination these plications are not represented as they appear in the fossil. There is a boldness of contour in the centre and more projecting one, which the drawing quite fails to convey any idea of; it is much too soft in outline in the figure [2 *a*]. In fig. 2 *b* the plications are still more feebly rendered.) Glenbane. Dublin Museum of Science and Art (Geological Survey Collection). (Page 112.)

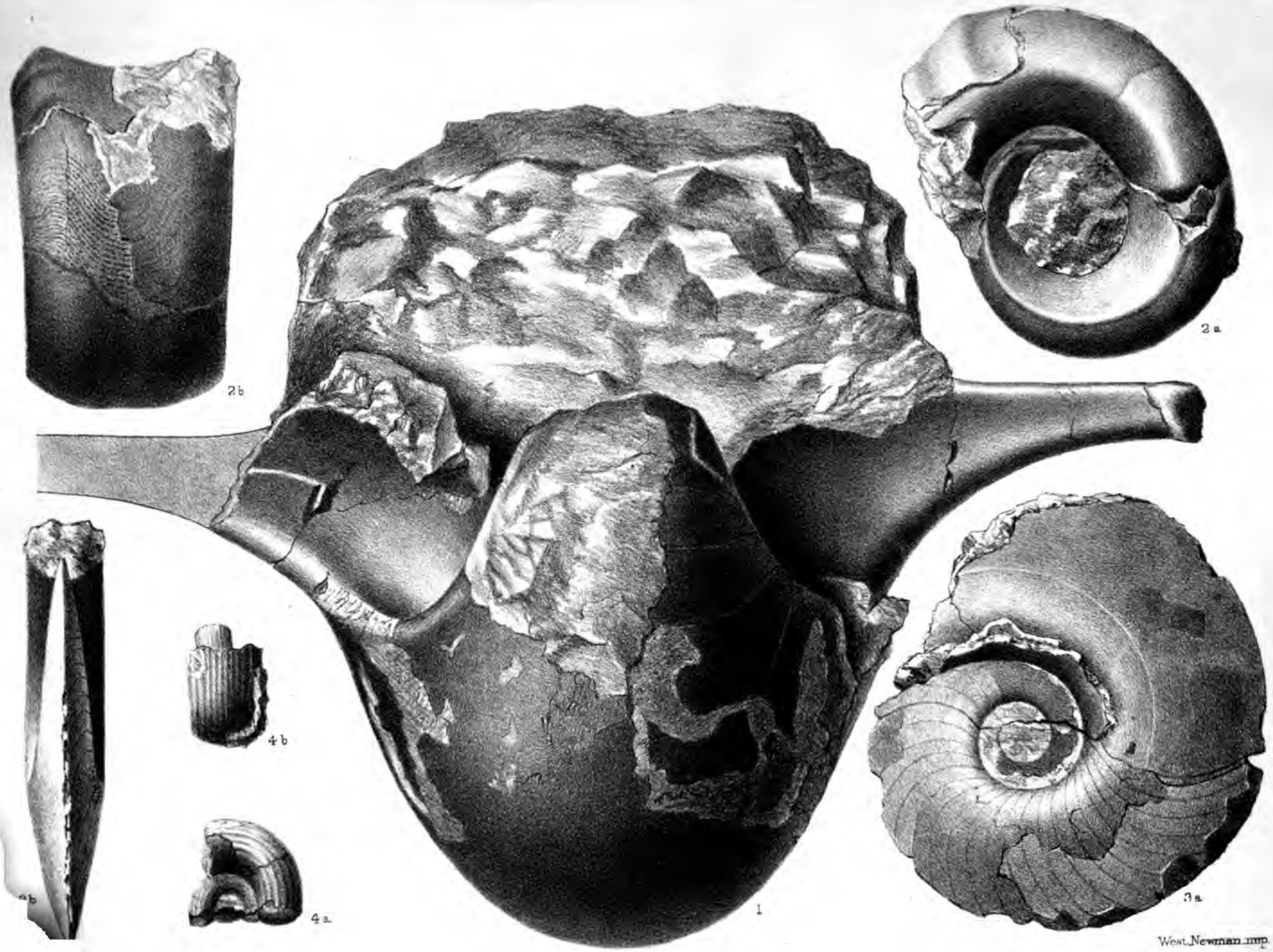
PHACOCERAS OXYSTOMUM, *J. Phillips*, sp.

Fig. 3 *a*. Lateral view of an imperfect specimen, showing part of the inner whorls and the septation, with the greater portion of the body-chamber. 3 *b*. Front view of the same, showing the knife-like periphery. Locality unknown. British Museum ("Gilbertson Collection"). (Page 108.)

DISCITOCERAS COSTELLATUM, *F. M'Coy*, sp.

Fig. 4 *a*. Lateral view of an imperfect specimen, which is probably part of the one figured by M'Coy ('Synopsis,' pl. ii, fig. 4). 4 *b*. Peripheral view of the same. Millicent, Clane. Dublin Museum of Science and Art ("Griffith Collection"). (Page 107.)

PLATE XXVIII.



West, Newman imp.

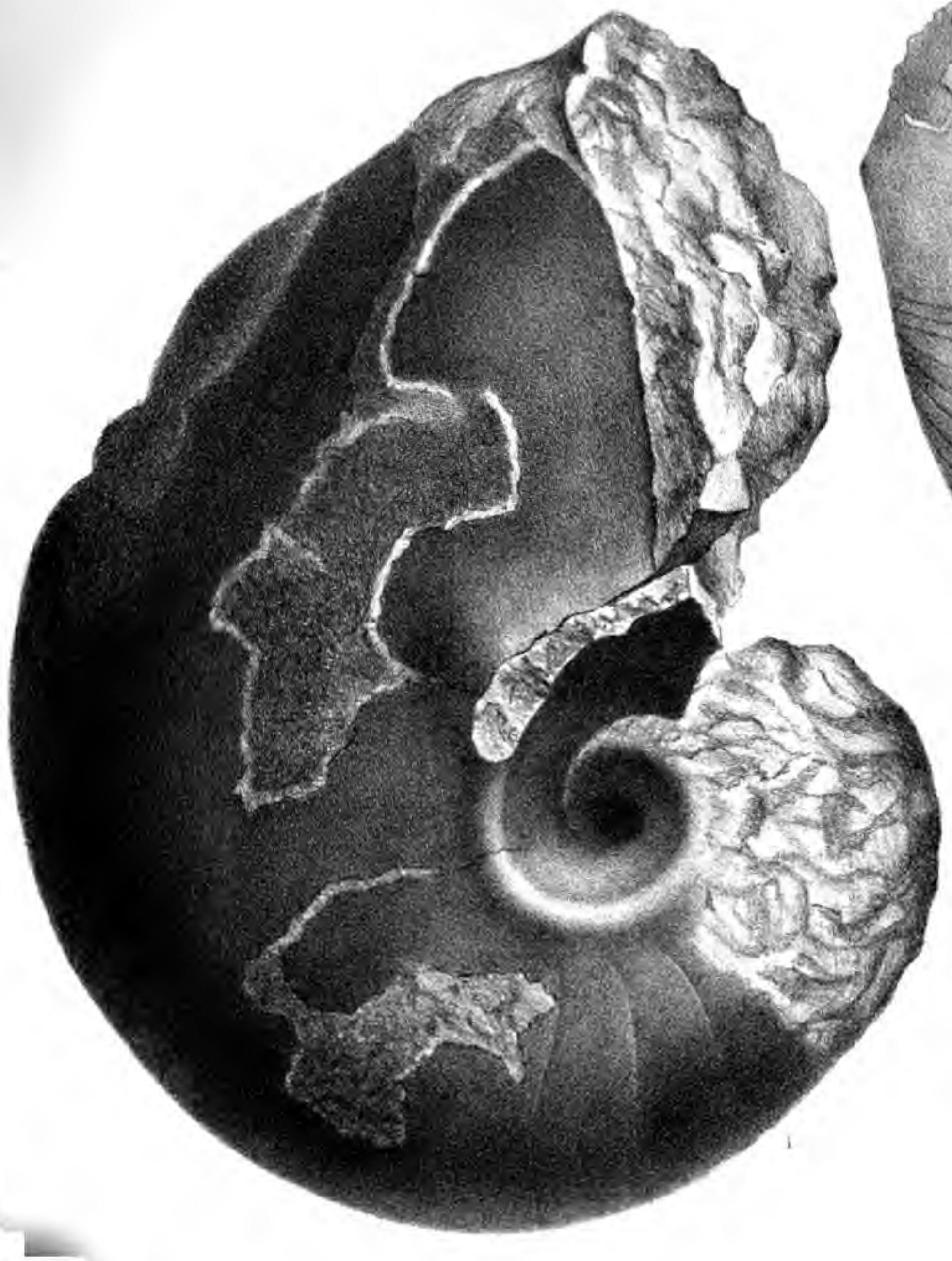
PLATE XXIX.

ACANTHONAUTILUS BISPINOSUS, *A. H. Foord.*

Fig. 1. Lateral view of the same individual as that figured on Pl. XXVIII, showing the umbilical cavity with its thick rim and the broken stump of the spine. (Page 118.)

PHACOCERAS ? RECTISUTURALE, sp. nov.

Fig. 2 *a*. Lateral view (cast) of the only individual known, showing the remarkably straight sutures and part of the body-chamber. 2 *b*. Peripheral view. 2 *c*. Front view, showing the angular border and steep walls of the umbilicus. County of Kildare (?). Public Museum, Belfast. (Page 111.)



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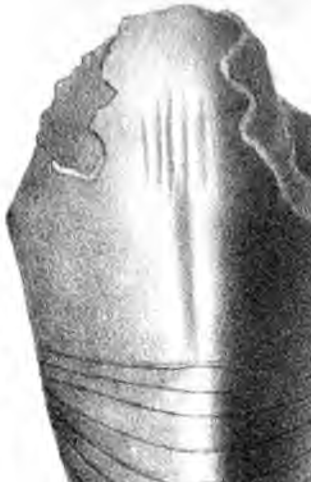

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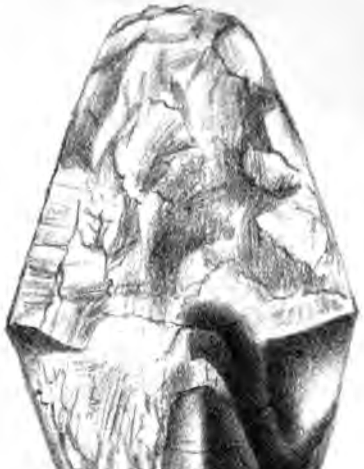
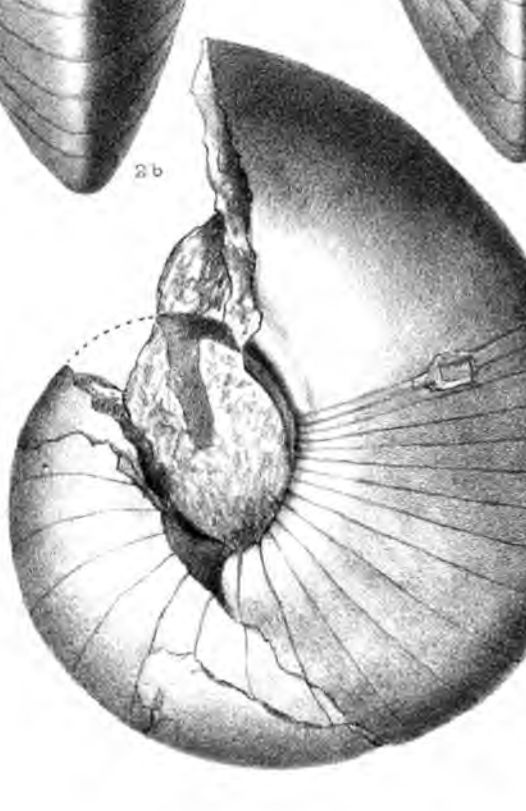


2c



2a

West, Newman imp.

PLATE XXX.

AIPOCERAS COMPRESSUM, *A. H. Foord.*

Fig. 1 *a.* Lateral view of a specimen wanting only a portion of the body-chamber; the flattened dorsal area and the sutures are well shown. 1 *b.* Front view of the same. Clane. Dublin Museum of Science and Art. (Page 116.)

COLOCERAS BISTRIALE, *J. Phillips*, sp.

Fig. 2 *a.* Lateral view of a well-preserved specimen, showing the two fine ridges that encircle the inner whorls close to the umbilical border. 2 *b.* Front view of the same individual, showing the broad peripheral area. 2 *c.* Peripheral view of the same, exhibiting on the cast of the body-chamber a sharply defined impression of a former edge of the aperture, with the hyponomic sinus. Tomdeely South, county of Limerick. Dublin Museum of Science and Art (Geological Survey Collection). (Page 115.)

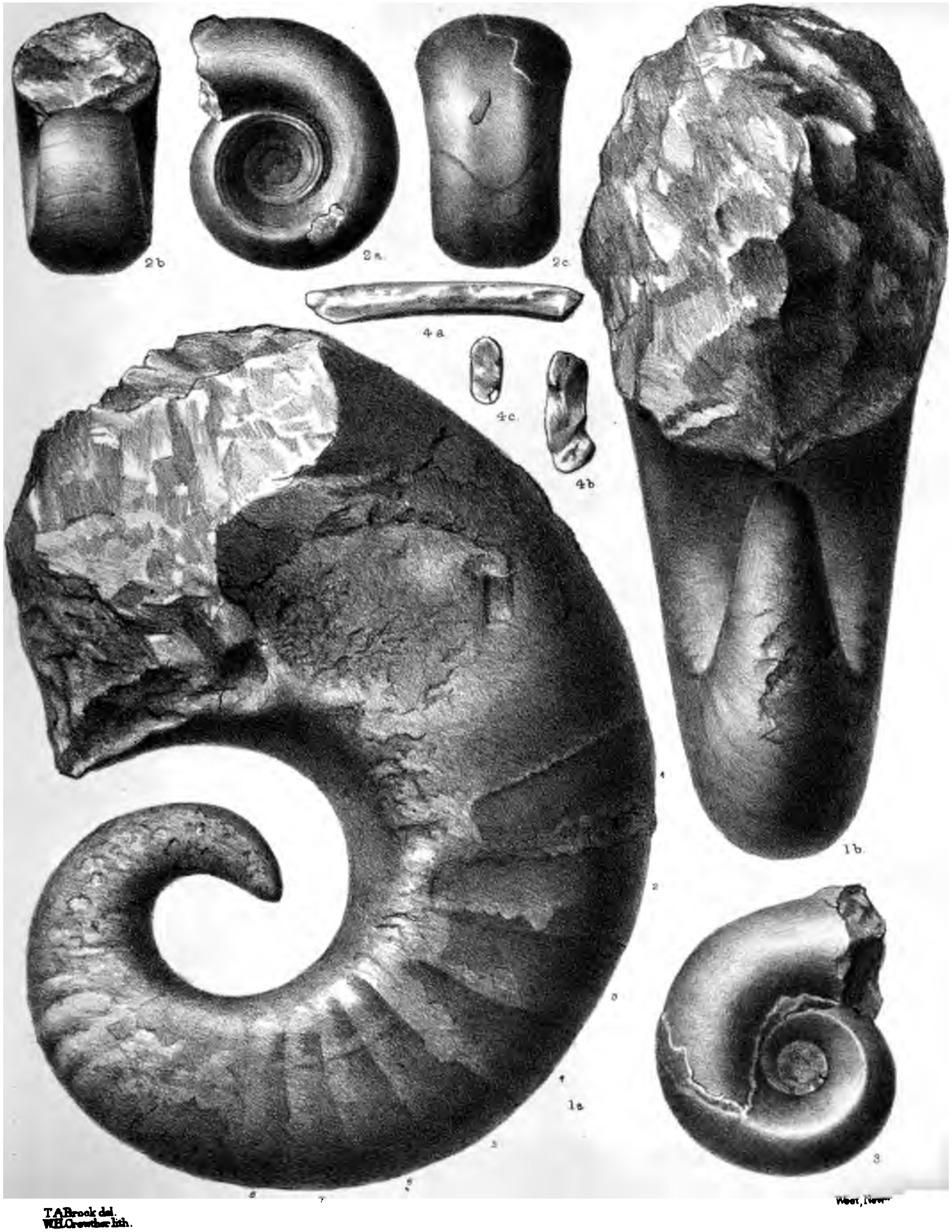
COLOCERAS COYANUM, *A. d'Orbigny*, sp.

Fig. 3. Lateral view of the type specimen figured by M'Coy under the name of *Temnocheilus pinguis* ('Synopsis,' pl. iv, fig. 12, which is a reversed view of the fossil; it is represented correctly in my figure). Kilmallock, county of Limerick. Dublin Museum of Science and Art ("Griffith Collection"). (Page 113.)

ACANTHONAUTILUS BISPINOSUS, *A. H. Foord.*

Fig. 4 *a.* Upper edge of spine drawn to show its thickness or smaller diameter; the left of the figure is the proximal end. 4 *b.* Proximal end where broken off from the shell, designed to show the two diameters of the spine. (The projection below, at right-hand side of figure, is merely matrix.) 4 *c.* Distal extremity. (Page 118.)

PLATE XXX.



T.A.Brock del.
W.H.Crowther lith.

West, New

PLATE XXXI.

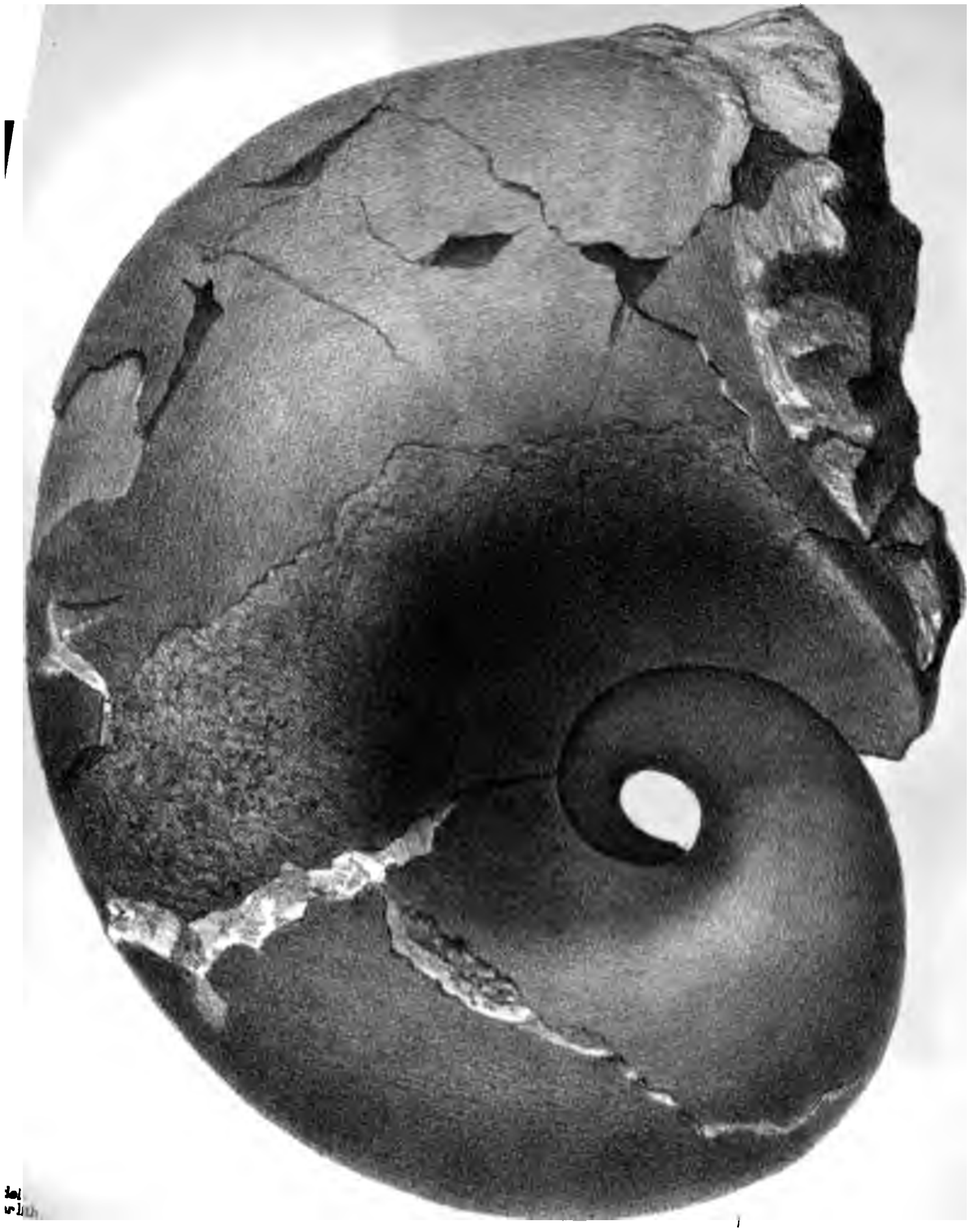
ASYMPTOCERAS CRASSILABRUM, sp. nov.

Fig. 1. Lateral view of a nearly perfect though somewhat distorted individual.

Fig. 2. Front view of a slightly distorted individual in which the thickened lip is well developed.

Both specimens from Clane. Dublin Museum of Science and Art. (Page 122.)

PLATE XXX



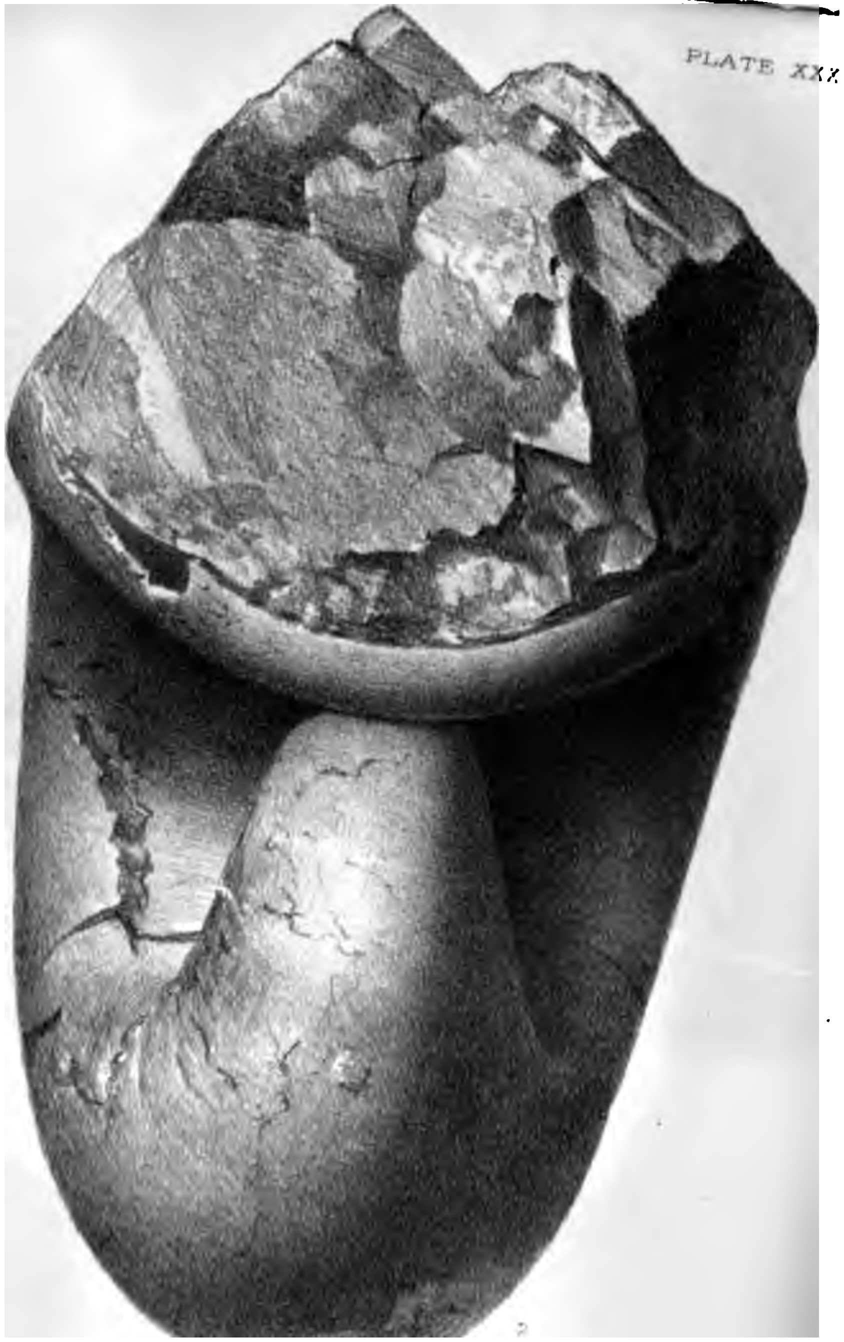


PLATE XXXII.

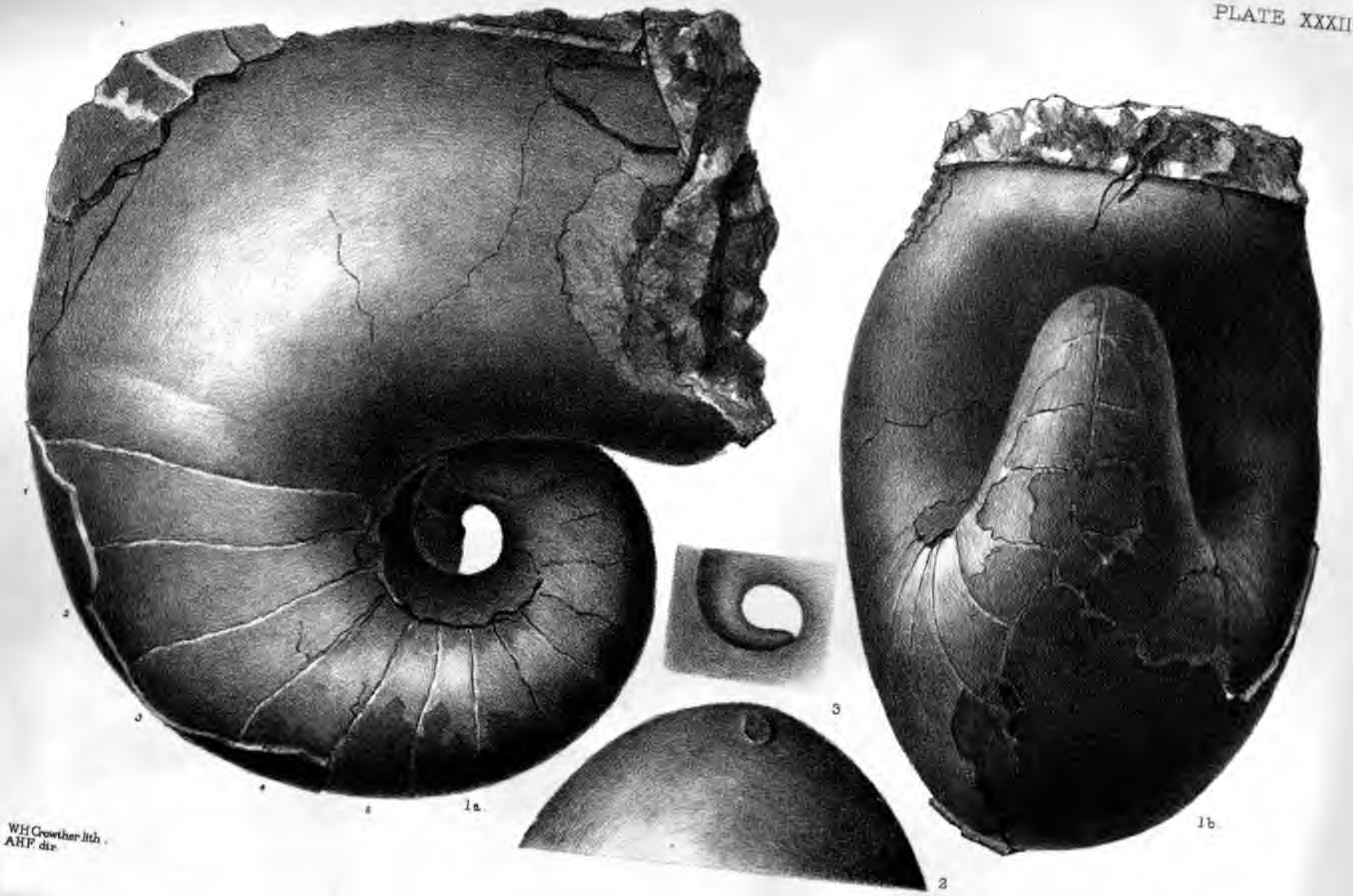
ASYMPTOCERAS FOORDI, *A. Hyatt.*

Fig. 1 *a*. Lateral view of a somewhat distorted specimen, showing the inflation of the inferior border of the aperture, and the septation. 1 *b*. Front view of the same, showing the septa; the median longitudinal groove cutting through the latter indicates the position of the siphuncle. Rathkeale, county of Limerick. British Museum. (Page 124.)

Fig. 2. Upper part of base of body-chamber of another individual, showing the position of the siphuncle close to the peripheral border. Kildare (probably Clane). Dublin Museum of Science and Art. (Page 124.)

Fig. 3. Initial whorl of another specimen, somewhat larger than the one represented by fig. 1 *a*, in which this part is perfect. Clane. Dublin Museum of Science and Art. (Page 124.)

PLATE XXXII.



W.H. Crowther lith.
AHF. dir.

West, Newman imp.

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177—194 and Table of Contents	XXIV, XXV	1871	June, 1872

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VOL. I.

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BY

W. BOYD DAWKINS, M.A., F.R.S.,

AND

W. AYSHFORD SANFORD, F.G.S.

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